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March 27, 2018

Subject: Union Carbide Corporation Technology Park, 2017 Groundwater Monitoring Report

Dear Mr. Cetin,

On behalf of Union Carbide Corporation (UCC), CH2M is pleased to submit the 2017 Groundwater Monitoring Report for the UCC Technology Park in South Charleston, West Virginia.

If you have any questions or comments please contact Jerome Cibrik at 304-747-7788.

Regards,

A handwritten signature in blue ink, appearing to read 'Paul Weber', with a stylized flourish at the end.

Paul Weber  
CH2M HILL  
Project Manager

cc: Jerome Cibrik/UCC  
Erich Weissbart/USEPA  
Luis Pizarro/USEPA

FINAL

# 2017 Groundwater Monitoring Report Union Carbide Corporation Technology Park South Charleston, West Virginia

*Prepared for*

Union Carbide Corporation

March 2018



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# Acronyms and Abbreviations

CCR	<i>Current Conditions Report</i>
GWMP	groundwater monitoring plan
GWMR	groundwater monitoring report
PCE	tetrachloroethene
RSL	regional screening level
SIM	selective ion monitoring
site	Union Carbide Corporation Technology Park, South Charleston, West Virginia
UCC	Union Carbide Corporation
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

# Introduction

This groundwater monitoring report (GWMR) has been prepared for the Union Carbide Corporation (UCC) Technology Park in South Charleston, West Virginia (site; Figure 1-1). This GWMR presents the data and findings for groundwater sampling conducted in 2017.

The U.S. Environmental Protection Agency (USEPA) issued its final decision for the site on December 17, 2010, and the West Virginia Department of Environmental Protection incorporated the final decision into a revised Resource Conservation and Recovery Act permit for the site on February 2, 2012 (WVDEP 2012). Long-term groundwater monitoring in accordance with the agency-approved groundwater monitoring plan (GWMP) (CH2M HILL Inc. [CH2M] 2009) is a component of the final decision for the site.

Groundwater monitoring at the site was conducted in accordance with the GWMP to meet the following objectives:

- Monitor water levels to evaluate potential changes in groundwater flow directions
- Monitor constituent concentrations to evaluate trends
- Monitor constituent concentrations to evaluate groundwater conditions in Ward Hollow
- Monitor constituent concentrations to evaluate groundwater conditions in the Greenhouse Area
- Evaluate the integrity of the monitoring wells by conducting inspections
- Monitor the effectiveness of corrective measures

Additional groundwater monitoring, beyond that which is required in the GWMP, was conducted for Ward Hollow in 2017 to further evaluate observed increases in groundwater constituent concentrations in some of the Ward Hollow monitoring wells. The additional monitoring consisted of increased frequency of groundwater monitoring (conducted quarterly). This GWMR includes the results of the additional monitoring completed in 2017.

# Background

The site covers 574 acres in the city of South Charleston, West Virginia, including 267 acres that have been sold or donated to other parties. UCC has retained the remaining 307 acres, which consist largely of the landfills and areas surrounding the landfills. Topography at the site is generally steep, with flatter, developed areas at the top of hills. Other portions of the site terrain have been altered by the construction of the Lower Ward Landfill, Ward A Landfill, and Ward B Landfill (Figure 1-1). The elevation of the site ranges from 580 to 1,090 feet above mean sea level.

The areas of groundwater contamination addressed in this GWMR are Ward Hollow and the Greenhouse Area, both of which are discussed in detail in the *Current Conditions Report* (CCR; CH2M 2008) and summarized below.

## 2.1 Ward Hollow

The Lower Ward Landfill, Ward A Landfill, Ward B Landfill, and a former brine well north of Lower Ward Landfill have contaminated the groundwater in Ward Hollow. Contaminated groundwater has migrated from these sources to the underlying weathered bedrock and then downgradient into Ward Hollow. The most prominent constituents present within this plume are 1,4-dioxane, benzene, bis(2-chloroisopropyl)ether, and barium.

## 2.2 Greenhouse Area

The source of groundwater contamination in the Greenhouse Area is unknown. Two monitoring wells (WVU-MW04 and MW-104A) screened in the Mahoning Sandstone have exhibited detectable concentrations of volatile organic compounds (VOCs).

# Groundwater Monitoring

The GWMP requires groundwater samples and water levels to be collected every 9 months at the locations shown on Figure 3-1 (CH2M 2009). Per the GWMP, the 2017 sampling was scheduled to occur in September for the Greenhouse Area. For Ward Hollow, some of the wells were not accessible in September 2017 because of maintenance on the Interstate 64 bridge; therefore, groundwater sampling for Ward Hollow was completed in February, May, and December 2017. This section summarizes how the sampling was conducted and observations made during sampling activities.

## 3.1 Water Level Measurements

Table 3-1 lists water levels and groundwater elevations measured in February, May, and December 2017. Table 3-2 lists the well construction details. During each event, measurements were collected over a 12-hour period using a handheld water level meter. Water levels were collected from monitoring wells, piezometers, and staff gauges during each event. Groundwater elevation data from the monitoring wells and piezometers were used to analyze the potentiometric surface and groundwater flow patterns.

## 3.2 Groundwater Sampling

Groundwater samples were collected at the Greenhouse Area in September 2017 in accordance with the GWMP (CH2M 2009). Groundwater samples also were collected from Ward Hollow in February, May, and December 2017; however, samples were not collected for Ward Hollow during the September 2017 event because of road construction activities that prevented safe access to some of the monitoring wells in the area. Table 3-3 lists the analytical suites and sample identifiers for the monitoring wells sampled. Sampling was conducted using low-flow sampling protocols (USEPA 2002) or volumetric purging if low-flow was not possible based on historical data for a given monitoring well.

Monitoring locations for the Ward Hollow groundwater plume consists of downgradient wells, sentinel wells, and impacted wells (Table 3-3). Downgradient wells are the wells that are furthest downgradient and typically have constituent concentrations that are below screening levels. The sentinel wells are the most downgradient wells that consistently have constituent concentrations above screening levels. Impacted wells are wells immediately downgradient of the landfills.

The groundwater samples collected from Ward Hollow were analyzed for VOCs, semivolatile organic compounds, and dissolved metals. The two monitoring wells sampled in the Greenhouse Area (WVU-MW04 and MW-104A) historically have contained concentrations of VOCs above screening levels; therefore, the samples from these wells were only analyzed for VOCs.

## 3.3 Leachate Collection System Sampling

Grab samples of the leachate in the Lower Ward Landfill leachate collection system were collected in February, May, and December 2017 to better understand concentrations leaching from the landfill. The leachate samples were analyzed for VOCs, semivolatile organic compounds, and dissolved metals.

# Results

## 4.1 Groundwater Flow Patterns

Groundwater level data, along with the top-of-casing elevations, were used to determine groundwater elevations at the site and prepare a potentiometric surface map. Table 3-1 presents the water level measurements and calculated elevations for each monitoring well, piezometer, and staff gauge.

### 4.1.1 Ward Hollow

Consistent with the topography of Ward Hollow, groundwater flow is to the northwest, toward the Kanawha River. Figure 4-1 shows the potentiometric surface of the Upper Freeport Formation within Ward Hollow for data collected on December 12, 2017. Water levels observed in February and May 2017 were consistent with the groundwater flow patterns observed in December 2017 and previous years; therefore, only the December 2017 results were mapped.

### 4.1.2 Greenhouse Area

Because of insufficient data, a potentiometric surface map was not prepared for the Greenhouse Area for the September 2017 event. Groundwater levels erroneously were only collected from the two monitoring wells that are part of the sampling network and not from the rest of the Greenhouse Area wells. Historically, groundwater in this area flows to the north, toward the Kanawha River.

## 4.2 Constituent Concentration Evaluation

Tables 4-1 and 4-2 list the analytical results for detected constituents in groundwater and leachate for Ward Hollow and the Greenhouse Area, respectively. The analytical results were compared to USEPA maximum contaminant levels (USEPA 2009), or if a maximum contaminant level was not available for a detected constituent, the USEPA adjusted tap water regional screening level (RSL) (USEPA 2017) was used. USEPA RSLs are based on a target cancer risk equal to  $1 \times 10^{-6}$  and an adjusted noncancer hazard quotient of 0.1. The noncancer RSLs are adjusted to account for potential additive effects. These comparisons are provided in Tables 4-1 and 4-2. Appendix A contains the laboratory data packages and the data quality evaluation memorandum.

### 4.2.1 Ward Hollow

A comparison of the analytical results to screening levels (Table 4-1) shows that 1,4-dioxane, benzene, bis(2-chloroisopropyl)ether, and barium remain the most prominent constituents present within this groundwater plume. Figures 4-3 through 4-6 show the lateral extents of 1,4-dioxane, bis(2-chloroisopropyl)ether, benzene, , and barium in Ward Hollow. 1,4-Dioxane and bis(2-chloroisopropyl)ether have the largest lateral extent in groundwater, which is observed vertically within the aquifer as well. Figures 4-7 and 4-8 show the vertical extents of 1,4-dioxane and bis(2-chloroisopropyl)ether, respectively, in Ward Hollow. 1,4-Dioxane is observed throughout the aquifer, whereas bis(2-chloroisopropyl)ether is observed primarily within the shallow aquifer in the monitoring wells closest to the landfill as well as deeper within the aquifer in downgradient monitoring wells.

Analytical data collected from the 2017 sampling events for Ward Hollow show that exceedances for benzene and bis(2-chloroisopropyl)ether remain delineated downgradient by MW-28. However, 1,4-dioxane and barium were detected at a concentrations above the screening level in downgradient monitoring well MW-31. Exceedances of the 1,4-dioxane screening level in downgradient monitoring well MW-31 have been observed in previous sampling events; however, December 2016 was the first

time barium concentrations exceeded the screening level in MW-31, and this was observed again in December 2017. The source of barium contaminations in Ward Hollow does not appear to be related to the landfills because concentrations downgradient of the landfills are an order of magnitude higher than what is observed in the leachate collection system. The source of barium contamination is assumed to be the former brine well next to MW-01 (Figure 1-1).

Other constituent concentrations that exceeded screening levels were arsenic, cadmium, lead, bis(2-chloroethyl)ether, and naphthalene. Arsenic concentrations exceeded the screening level in monitoring wells MW-01, MW-23, MW-26, MW-28, and MW-34. Arsenic concentrations observed in groundwater throughout Ward Hollow appear to be representative of naturally occurring levels. The arsenic concentrations in Ward Hollow are similar to those observed previously in monitoring wells outside the boundary of the groundwater plume that are screened in the Upper Freeport Formation (e.g., MW-29 and MW-30). In addition, detections of arsenic in Ward Hollow are highly variable (e.g., arsenic was only detected in MW-34 during the May 2017 event), which is different than what is observed for other constituents in the groundwater plume. Cadmium concentrations exceeded the screening level in all wells except the two most downgradient wells (MW-31 and MW-32).

Bis(2-chloroethyl)ether concentrations exceeded the screening level in wells MW-23, MW-26, and MW-35 at least once. Naphthalene and lead also exceeded their respective screening level in MW-01.

The groundwater plume stability was evaluated based on monotonic trend analysis of groundwater data using the Mann-Kendall non-parametric statistical test (Gilbert 1987) to investigate whether constituent concentrations in groundwater are increasing, decreasing, or stable. Mann-Kendall statistical tests were performed for four key constituents (1,4-dioxane, bis(2-chloroisopropyl)ether, benzene, and barium) using groundwater analytical data collected at six monitoring wells and the leachate collection system. The Mann-Kendall statistical tests were performed for two different data sets; one for all data and the other for data from 2011 through 2017. The results of Mann-Kendall statistical tests along with graphs showing concentrations over time<sup>1</sup> are provided in Appendix B. The trends were stable or decreasing except for the following:

- 1,4-Dioxane: Monitoring wells MW-31 and MW-01 exhibit an increasing trend for all data. Visual observation of MW-31 data indicate increasing trends from 2004 through 2006 and from 2013 through 2017, with the maximum detected concentrations being observed in December 2017. Although MW-01 data exhibit an increasing trend for all data but there is no trend for data from 2011 to 2017.
- Bis(2-chloroisopropyl)ether: Monitoring wells MW-01, MW-23, and MW-26 exhibit increasing trends for all data; however, MW-01 and MW-26 exhibit stable trends for data from 2011 to 2017.
- Benzene: Monitoring wells MW-01, MW-23, and MW-26 exhibit increasing trends for all data; however, MW-26 exhibits a stable trend for data from 2011 to 2017. The maximum detected concentration of benzene for both MW-01 and MW-23 was observed in 2017.
- Barium: Monitoring wells MW-23, MW-26, MW-28, MW-31, and MW-32 exhibit increasing trends for all data; however, only MW-23 and MW-31 exhibit increasing trends for data from 2011 to 2017.

#### 4.2.2 Leachate Collection System

Analytical data collected from the leachate in 2017 show that the most prominent constituents (1,4-dioxane, benzene, bis(2-chloroisopropyl)ether, and barium) within the groundwater plume also are observed in the leachate at concentrations above screening levels. In addition, 2,4-dimethylphenol,

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<sup>1</sup> Monitoring wells with three or more consecutive non-detect results were not plotted.

2-methylnaphthalene, naphthalene, phenol, 1,2-dichloroethane, 1,2-dichloropropane, and arsenic were detected above their respective screening levels (Table 4-1).

Mann-Kendall statistical tests were performed for 1,4-dioxane, bis(2-chloroisopropyl)ether, benzene, and barium using analytical data for the leachate. The Mann-Kendall statistical tests were performed for two different data sets; one for all data and the other for data from 2011 to 2017. Appendix B contains the Mann-Kendall statistical test results along with graphs showing concentrations over time. Trends based on all data are stable for 1,4-dioxane and bis(2-chloroisopropyl)ether, and are decreasing for benzene and barium. Trends based on data from 2011 through 2017 are stable for 1,4-dioxane and barium, and are decreasing for benzene and bis(2-chloroisopropyl)ether.

### 4.2.3 Greenhouse Area

The September 2017 analytical data for the Greenhouse Area showed that tetrachloroethene (PCE) concentrations exceeded the screening level in WVU-MW04 (Figure 4-9). No other VOCs exceeded screening levels in the Greenhouse Area in 2017.

Mann-Kendall statistical tests were performed using groundwater analytical data collected at the two Greenhouse Area monitoring wells for two key constituents (PCE and trichloroethene); the Mann-Kendall statistical test results along with graphs showing concentrations over time are in Appendix B. The key constituents for the Greenhouse Area showed either no trend or decreasing trends.

## 4.3 1,4-Dioxane Analysis Method Comparison

The analysis of 1,4-dioxane in water is complicated because of the physical properties (namely solubility in water and vapor pressure) of 1,4-dioxane. The extraction efficiency of 1,4-dioxane from water is low because of the compound's miscibility with water. To improve sensitivity and accuracy in the analysis of 1,4-dioxane, selective ion monitoring (SIM) and isotope dilution methods have been developed. The addition of SIM increases the sensitivity of the analytical methods by monitoring selected ions that are specific and representative to the target analyte. Isotope dilution methods use an isotopic-labeled analog of the analyte (such as 1,4-dioxane-d8, where the eight hydrogen atoms in 1,4-dioxane have been replaced by deuterium atoms), which is added to the sample before sample preparation and is used as an internal standard to correct for the low extraction efficiency of the compound during sample preparation and analysis that is common during the analysis of 1,4-dioxane. Isotope dilution methods increase the accuracy of the analysis method through these corrections.

UCC is considering switching to the isotope dilution method because of its increased accuracy of the analysis method for 1,4-dioxane. The 8270 SIM method was used historically to analyze the wells at Ward Hollow. During the December 2017 event, samples were collected from MW-31 and MW-32 for 1,4-dioxane and analyzed using the two different methods, 8270 SIM and 8270 SIM isotope dilution. The results presented in Table 4-3 show that 1,4-dioxane exceeded the screening level in MW-31 using both methods, but the 8270 SIM isotope dilution result was approximately twice as high as the 8270 SIM method. Concentrations of 1,4-dioxane in MW-32 exhibited no detection using both methods.

# Summary

Groundwater monitoring for Ward Hollow and the Greenhouse Area in 2017 shows that groundwater flow patterns have remained stable and are consistent with the conceptual site model presented in the CCR (CH2M 2008).

Analytical data collected from 2003 through 2017 for Ward Hollow generally show that bis(2-chloroisopropyl)ether and benzene have a similar distribution, and concentrations are below their respective screening levels in the downgradient monitoring wells. However, 1,4-dioxane and barium were detected in one of the downgradient wells (MW-31) above their respective screening levels.

1,4-Dioxane has exhibited an increasing trend in MW-31 since 2012, with the maximum concentration detected in 2017. Barium has exhibited increasing concentrations at MW-31 since early 2014. Arsenic concentrations occasionally exceeded the screening level in some Ward Hollow monitoring wells; however, arsenic is most likely representative of naturally occurring levels. The groundwater concentration trends based on the Mann-Kendall statistical test for Ward Hollow were either stable or decreasing, except for the following:

- 1,4-Dioxane: Increasing trend in one offsite monitoring well and one onsite monitoring well for all data, but the trend is stable for the one onsite well for data from 2011 through 2017.
- Benzene: Increasing trend in three onsite monitoring wells for all data, but the trends are stable for one well for data from 2011 through 2017.
- Bis(2-chloroisopropyl)ether: Increasing trend in three onsite monitoring wells for all data, but the trends are stable for two wells for data from 2011 through 2017.
- Barium: Increasing trend in three onsite monitoring wells and two offsite monitoring wells for all data, but the trends are stable for two onsite monitoring wells and one offsite monitoring well for data from 2011 through 2017.

The 2017 analytical data for the Greenhouse Area show an exceedance of the screening level for PCE in WVU-MW04. No other VOCs exceeded screening levels in the Greenhouse Area in 2017. The key constituents for the Greenhouse Area showed stable or decreasing trends.

Based on the results of monitoring conducted in 2017, it is still recommended that a new monitoring well be installed downgradient of MW-31 to better monitor the leading edge of the groundwater plume. UCC continues to work with the offsite property owner to install the new monitoring well and hopes to accomplish this in 2018. In addition, it is recommended that quarterly groundwater monitoring be continued. Lastly, UCC will continue to evaluate switching to the 8270 SIM isotope dilution method for 1,4-dioxane analysis in key monitoring wells (e.g., MW-31 and MW-32).

# References

CH2M HILL Inc. (CH2M). 2008. *Current Conditions Report*. UCC Technology Park. Prepared for Union Carbide Corporation. March.

CH2M HILL Inc. (CH2M). 2009. *Groundwater Monitoring Plan*. UCC Technology Park. Prepared for Union Carbide Corporation. January.

Gilbert, R. O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Wiley, New York.

U.S. Environmental Protection Agency (USEPA). 2002. *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers, Ground Water Forum Issue Paper*. Office of Solid Waste and Emergency Response. EPA 542-S-02-001. May.

U.S. Environmental Protection Agency (USEPA). 2009. *National Primary Drinking Water Regulations*. EPA 816-F-09-004. May.

U.S. Environmental Protection Agency (USEPA). 2010. Final Decision and Response to Comments. December 17.

U.S. Environmental Protection Agency (USEPA). 2017. *Regional Screening Levels for Chemical Contaminants at Superfund Sites*. November.

West Virginia Department of Environmental Protection. 2012. "Final Decision into a Revised Resource Conservation and Recovery Act Permit for the UCC Technology Park." February 2.

Tables

**Table 3-1. 2017 Groundwater and Surface Water Elevation Data**

2017 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Location	Top of Casing Elevation (ft amsl)	February 2017		May 2017		September 2017		December 2017	
		Water Level (ft btoc)	Groundwater Elevation (ft amsl)	Water Level (ft btoc)	Groundwater Elevation (ft amsl)	Water Level (ft btoc)	Groundwater Elevation (ft amsl)	Water Level (ft btoc)	Groundwater Elevation (ft amsl)
		2/15/2017	2/15/2017	5/26/2017	5/26/2017	9/27/2017	9/27/2017	12/12/2017	12/12/2017
Monitoring Wells									
MW-01	622.34	2.64	619.70	1.50	620.84	NM	NA	2.12	620.22
MW-02	775.88	82.11	693.77	82.60	693.28	NM	NA	82.77	693.11
MW-04	770.05	8.17	761.88	7.98	762.07	NM	NA	8.12	761.93
MW-05	800.71	31.20	769.51	31.57	769.14	NM	NA	33.01	767.70
MW-06	801.18	58.69	742.49	58.65	742.53	NM	NA	59.09	742.09
MW-20	608.85	0.50	608.35	0.70	608.15	NM	NA	1.43	607.42
MW-21	608.69	0.50	608.19	0.37	608.32	NM	NA	0.83	607.86
MW-22	608.73	6.15	602.58	5.73	603.00	NM	NA	6.48	602.25
MW-23	617.65	12.82	604.83	17.62	600.03	NM	NA	13.92	603.73
MW-24	604.07	6.95	597.12	6.93	597.14	NM	NA	7.80	596.27
MW-25	606.70	10.42	596.28	10.25	596.45	NM	NA	11.12	595.58
MW-26	635.37	27.74	607.63	27.41	607.96	NM	NA	28.30	607.07
MW-27	621.09	31.00	590.09	30.73	590.36	NM	NA	30.62	590.47
MW-28	622.45	32.25	590.20	31.95	590.50	NM	NA	31.80	590.65
MW-29	801.50	118.44	683.06	118.30	683.20	NM	NA	118.70	682.80
MW-30	620.19	25.80	594.39	25.90	594.29	NM	NA	26.22	593.97
MW-31	592.06	15.30	576.76	14.78	577.28	NM	NA	15.72	576.34
MW-32	589.05	18.33	570.72	17.45	571.60	NM	NA	18.54	570.51
MW-34	623.65	10.61	613.04	10.44	613.21	NM	NA	10.83	612.82
MW-35	615.46	6.44	609.02	6.20	609.26	NM	NA	6.93	608.53
MW-104A	693.21	NM	NA	NM	NA	54.95	638.26	NM	NA
WVU-MW01	695.10	NM	NA	NM	NA	NM	NA	NM	NA
WVU-MW02	693.57	NM	NA	NM	NA	NM	NA	NM	NA
WVU-MW03	690.88	NM	NA	NM	NA	NM	NA	NM	NA
WVU-MW04	678.55	NM	NA	NM	NA	17.82	660.73	NM	NA
WVU-MW05	712.22	NM	NA	NM	NA	NM	NA	NM	NA
WVU-MW06	721.38	NM	NA	NM	NA	NM	NA	NM	NA
Piezometers									
P-06	784.00	7.93	776.07	8.51	775.49	NM	NA	9.42	774.58
P-11	767.20	6.62	760.58	5.46	761.74	NM	NA	9.28	757.92
P-13	769.90	84.64	685.26	90.80	679.10	NM	NA	99.82	670.08
P-14	770.70	44.49	726.21	31.36	739.34	NM	NA	44.89	725.81
Staff Gauges									
SG-01 (Next to MW-21)	599.00	0.86	598.14	0.10	598.90	NM	NA	-1.10	600.10
SG-02 (Next to MW-31)	584.00	3.40	580.60	3.40	580.60	NM	NA	3.36	580.64

**Notes:**

ft btoc = feet below top of casing

ft amsl = feet above mean sea level

NM = not measured

NA = not applicable or not available

**Table 3-2. Well Construction Table**  
2017 Groundwater Monitoring Report  
UCC Technology Park, South Charleston, West Virginia

Location	Lithology in Screened Interval	Ground Elevation (ft amsl)	Screen Elevation (ft amsl)		Screened Interval (ft bgs)	
			Top	Bottom	Top	Bottom
Monitoring Wells						
MW-01	Siltstone and Shale above Upper Freeport Sandstone	621.91	613	598	9	24
MW-02	Mahoning Sandstone	773.54	654	634	120	140
MW-04	Conemaugh Red Beds	770.84	745	735	26	36
MW-05	Red and Gray Claystone and Shale	799.45	761	741	38	58
MW-06	Mahoning Sandstone	799.59	680	660	120	140
MW-20	Upper Freeport Sandstone (deep)	606.61	548.1	529.1	58.5	77.5
MW-21	Upper Freeport Sandstone	606.80	578.7	558.7	28.1	48.1
MW-22	Siltstone and Shale above Upper Freeport Sandstone	606.96	596.46	576.46	10.50	30.50
MW-23	Upper Freeport Sandstone	614.51	NA	545.65	NA	68.86
MW-24	Upper Freeport Sandstone	600.95	NA	546.15	NA	54.80
MW-25	Upper Freeport Sandstone	603.52	NA	543.64	NA	59.88
MW-26	Upper Freeport Sandstone	632.28	568	548	64	84
MW-27	Upper Freeport Sandstone	618.21	558	538	60	80
MW-28	Upper Freeport Sandstone	619.55	562	542	58	78
MW-29	Upper Freeport Sandstone	799.63	610	590	190	210
MW-30	Upper Freeport Sandstone	620.51	556	536	65	85
MW-31	Upper Freeport Sandstone	590.26	540.07	520.07	50.19	70.19
MW-32	Upper Freeport Sandstone	587.34	529.02	508.72	58.32	78.62
MW-34	Upper Freeport Sandstone	620.95	565.5	545.5	55.5	75.5
MW-35	Upper Freeport Sandstone	612.73	569	549	44	64
WVU-MW03	Mahoning Sandstone	691*	654	634	37	57
WVU-MW04	Mahoning Sandstone	678.8*	657.3	637.3	21.5	41.5
WVU-MW05	Shale above the Mahoning Sandstone	712.5*	704.5	684.5	8	28
WVU-MW06	Mahoning Sandstone	721.5*	711.5	691.5	10	30
Technology Park Piezometers						
P-06	Clay and Siltstone	781.59	764	762	18	20
P-11	Landfill Waste	765.14	747	745	18	20
P-13	Clay and Siltstone	768.07	670	668	98	100
P-14	Claystone	768.12	721.6	719.6	46.5	48.5

**Notes:**

NA = not available

ft bgs = feet below ground surface

ft amsl = feet above mean seal level

\* = Estimated value. Survey data not available

**Table 3-3. 2017 Groundwater Sampling Summary***2017 Groundwater Monitoring Report**UCC Technology Park, South Charleston, West Virginia*

Monitoring Well	Well Type	Sample ID	Date Sampled	Analysis		
				VOCs	SVOCs	Dissolved Metals
MW-01	Impacted	MW01-GW-MMDDYY	2/24/2017, 5/25/2017, 12/27/2017	X	X	X
MW-21	Impacted	MW21-GW-MMDDYY	2/23/2017, 5/24/2017, 12/27/2017	X	X	X
MW-23	Sentinel	MW23-GW-MMDDYY	2/24/2017, 5/24/2017, 12/27/2017	X	X	X
MW-26	Sentinel	MW26-GW-MMDDYY	2/23/2017, 5/23/2017, 12/13/2017	X	X	X
MW-28	Sentinel	MW28-GW-MMDDYY	2/22/2017, 6/01/2017, 12/13/2017	X	X	X
MW-31	Downgradient	MW31-GW-MMDDYY	2/21/2017, 5/31/2017, 12/13/2017	X	X	X
MW-32	Downgradient	MW32-GW-MMDDYY	2/21/2017, 5/31/2017, 12/13/2017	X	X	X
MW-34	Impacted	MW34-GW-MMDDYY	2/24/2017, 6/01/2017, 12/27/2017	X	X	X
MW-35	Impacted	MW35-GW-MMDDYY	2/23/2017, 5/24/2017, 12/27/2017	X	X	X
WVU-MW04	Impacted	WVU04-GW-MMDDYY	9/27/2017	X		
MW-104A	Impacted	MW104A-GW-MMDDYY	9/27/2017	X		

**Notes:**

VOC = volatile organic compound

SVOC = semivolatile organic compound

Table 4-1. 2017 Detected Results for Ward Hollow Groundwater  
2017 Groundwater Monitoring Report  
UCC Technology Park, South Charleston, West Virginia

Location	Screening Level	Screening Level Source	MW01				MW21			MW23			MW26		
Sample ID			MW01-GW-022417	MW01-GW-022417D	MW01-GW-052517	MW01-GW-122717	MW21-GW-022317	MW21-GW-052417	MW21-GW-122717	MW23-GW-022417	MW23-GW-052417	MW23-GW-122717	MW26-GW-022317	MW26-GW-052317	MW26-GW-121317
Sample Date			2/24/2017	2/24/2017	5/25/2017	12/27/2017	2/23/2017	5/24/2017	12/27/2017	2/24/2017	5/24/2017	12/27/2017	2/23/2017	5/23/2017	12/13/2017
Analyte															
Metals (mg/L)															
Arsenic	0.01	MCL	0.0138	0.0112	0.01 U	0.011	0.01 U	0.01 U	0.01 U	0.0182	0.01 U	0.0155	0.0169	0.01 U	0.01 U
Barium	2	MCL	55.1	56	53.4	54.1	55.9	53.9	51.4	43	41	52.9	59.6	59.8	58.2
Cadmium	0.005	MCL	0.0109	0.011	0.00896	0.00599	0.0101	0.00869	0.00535	0.0101	0.00751	0.00591	0.00999	0.00878	0.00989
Chromium, total	0.1	MCL	0.005 U	0.005 U	0.005 U	0.0117 B	0.005 U	0.005 U	0.0258	0.00516	0.005 U	0.012	0.005 U	0.005 U	0.005 U
Lead	0.015	MCL	0.01 U	0.0153	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.0147	0.01 U	0.01 U	0.0102	0.01 U	0.01 U
Selenium	0.05	MCL	0.0319	0.034	0.00942	0.0124	0.0303	0.0107	0.0103	0.0331	0.0123	0.011	0.0287	0.0122	0.0253
Semivolatile Organic Compounds (µg/L)															
2,4-Dimethylphenol	36	Adjusted Tapwater RSL	5.75 U	5.49 U	5.32 U	5.1 U	5.38 U	5.26 U	5.56 U	0.543 U	0.521 U	5.68 U	0.581 U	0.51 U	5.38 U
2-Methylnaphthalene	3.6	Adjusted Tapwater RSL	5.75 U	5.49 U	5.32 U	5.1 U	5.38 UL	5.26 U	5.56 U	0.665	0.521 U	5.68 U	0.581 UL	0.51 U	5.38 U
3 & 4 Methylphenol	--	--	5.75 U	5.49 U	5.32 U	5.1 U	5.38 U	5.26 U	5.56 U	0.543 U	0.521 U	5.68 U	0.581 U	0.51 U	5.38 U
Acenaphthene	53	Adjusted Tapwater RSL	5.75 U	5.49 U	5.32 U	5.1 U	5.38 UL	5.26 U	5.56 U	0.543 U	0.521 U	5.68 U	0.581 UL	0.51 U	5.38 U
Acenaphthylene	--	--	5.75 U	5.49 U	5.32 U	5.1 U	5.38 UL	5.26 U	5.56 U	0.543 U	0.521 U	5.68 U	0.581 UL	0.51 U	5.38 U
Anthracene	180	Adjusted Tapwater RSL	5.75 U	5.49 U	5.32 U	5.1 U	5.38 UL	5.26 U	5.56 U	0.543 U	0.521 U	5.68 U	0.581 UL	0.51 U	5.38 U
Benzyl Butyl Phthalate	16	Adjusted Tapwater RSL	5.75 U	5.49 U	5.32 U	5.1 U	5.38 U	5.26 U	5.56 U	0.543 U	0.521 U	5.68 U	0.581 U	0.51 U	5.38 U
Bis(2-chloroethyl) Ether	0.014	Adjusted Tapwater RSL	5.75 U	5.49 U	5.32 U	5.1 U	5.38 U	5.26 U	5.56 U	1.41	1.15	5.68 U	2.12	2.02	5.38 U
Bis(2-chloroisopropyl) Ether	71	Adjusted Tapwater RSL	751	799	573	705	455	560	548	457	355	466	756	508	331 J
Diethyl Phthalate	1500	Adjusted Tapwater RSL	5.75 U	5.49 U	5.32 U	5.1 U	5.38 U	5.26 U	5.56 U	0.543 U	3.77	5.68 U	0.581 U	0.51 U	5.38 U
Fluoranthene	80	Adjusted Tapwater RSL	5.75 U	5.49 U	5.32 U	5.1 U	5.38 U	5.26 U	5.56 U	0.543 U	0.521 U	5.68 U	0.581 U	0.51 U	5.38 U
Fluorene	29	Adjusted Tapwater RSL	5.75 U	5.49 U	5.32 U	5.1 U	5.38 UL	5.26 U	5.56 U	0.543 U	0.521 U	5.68 U	0.581 UL	0.51 U	5.38 U
Naphthalene	0.17	Adjusted Tapwater RSL	13.5	15.2	12	14.4	5.38 U	5.26 U	5.56 U	0.543 U	0.521 U	5.68 U	0.581 UL	0.51 U	5.38 U
Phenanthrene	--	--	5.75 U	5.49 U	5.32 U	5.1 U	5.38 U	5.26 U	5.56 U	0.543 U	0.521 U	5.68 U	0.581 U	0.51 U	5.38 U
Phenol	580	Adjusted Tapwater RSL	5.75 U	5.49 U	5.32 U	5.1 U	5.38 U	5.26 U	5.56 U	0.543 U	0.521 U	5.68 U	0.581 U	0.51 U	5.38 U
Volatile Organic Compounds (µg/L)															
1,1,2-Trichloroethane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	600	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tapwater RSL	240 L	224 L	210 L	211 L	242	235 L	248 L	147 L	228 L	211 L	203 L	206 L	229 L
Acetone	1400	Adjusted Tapwater RSL	7.33	9.36	8.93 L	5 U	5 U	5 UL	5 U	8.62	6.01 L	12.2 B	5 U	5 UL	5 U
Benzene	5	MCL	31.1	30.3	34.3 L	34.7	22.9	24.7	22.1	5.88	7.06	11.9	20.1	20.6	17.9
Carbon Disulfide	81	MCL	1 U	1 U	1 U	1 U	1.08	1 U	1 U	1 U	1 U	1 U	1.17	1 U	1 U
Chlorobenzene	100	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	700	MCL	26.5	25.6	25.3 L	28.8	5.97	5.46	6.17	1 U	1 U	1.49	2.9	2.37	2.71
2-Butanone	560	Adjusted Tapwater RSL	5 U	5 U	5 UL	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-Pentanone	630	Adjusted Tapwater RSL	5 U	5 U	5 UL	5 U	5 U	5 UL	5 U	5 U	5 UL	5 U	5 U	5 UL	5 U
Pyrene	12	Adjusted Tapwater RSL	5.75 U	5.49 U	5.32 U	5.1 U	5.38 U	5.26 U	5.56 U	0.543 U	0.521 U	5.68 U	0.581 U	0.51 U	5.38 U
Styrene	100	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	1000	MCL	3.07	3.04	3.33	3.51	1.83	1.84	1.85	1 U	1 U	1 U	1.38	1.45	1.34
Xylenes, total	10000	MCL	10.8	10.4	10.2	11.5	3.43	2.99	3.5	1 U	1 U	1.32	2.27	1.95	2.12

Notes:

B = The analyte was detected in the associated method and/or calibration blank  
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.  
L = The analyte was positively identified, but the associated numerical value may be biased low.  
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.  
UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.  
UL = The analyte was analyzed for but was not detected. The quantitation limit may be biased low.

MCL= maximum contaminant level

RSL= regional screening level

mg/L = Milligrams per Liter

µg/L = Micrograms per Liter

**Bold indicates the analyte was detected.**

Shading indicates the result exceeded screening criteria.

Table 4-1. 2017 Detected Results for Ward Hollow Groundwater  
2017 Groundwater Monitoring Report  
UCC Technology Park, South Charleston, West Virginia

Location Sample ID	Screening Level	Screening Level Source	MW28			MW31			MW32			MW34		
			MW28-GW-022217	MW28-GW-060117	MW28-GW-121317	MW31-GW-022117	MW31-GW-053117	MW31-GW-121317	MW32-GW-022117	MW32-GW-053117	MW32-GW-121317	MW34-GW-022417	MW34-GW-060117	MW34-GW-122717
Sample Date			2/22/2017	6/1/2017	12/13/2017	2/21/2017	5/31/2017	12/13/2017	2/21/2017	5/31/2017	12/13/2017	2/24/2017	6/1/2017	12/27/2017
Analyte														
Metals (mg/L)														
Arsenic	0.01	MCL	0.0119	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.0147	0.0106	0.0145
Barium	2	MCL	32.7	33.2	37.7	1.96	1.62	2	0.199	0.177	0.205	62.5	49.9	55.5
Cadmium	0.005	MCL	0.00753	0.00611	0.00726	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00945	0.00674	0.00535
Chromium, total	0.1	MCL	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Lead	0.015	MCL	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Selenium	0.05	MCL	0.0135	0.001 U	0.0262	0.00894	0.00449	0.012	0.001 U	0.001 U	0.00107	0.0181	0.00846	0.00637
Semivolatile Organic Compounds (µg/L)														
2,4-Dimethylphenol	36	Adjusted Tapwater RSL	0.526 U	5 U	11.8 U	0.51 U	0.51 U	5.43 U	0.549 U	0.543 U	0.556 U	0.526 U	0.575 U	2.66 U
2-Methylnaphthalene	3.6	Adjusted Tapwater RSL	0.526 UL	5 U	11.8 U	0.51 UL	0.51 U	5.43 U	0.549 UL	0.543 U	0.556 U	0.526 U	0.575 U	2.66 U
3 & 4 Methylphenol	--	--	0.526 U	5 U	11.8 U	0.51 U	0.51 U	5.43 U	0.549 U	0.543 U	0.556 U	0.526 U	0.575 U	2.66 U
Acenaphthene	53	Adjusted Tapwater RSL	0.526 UL	5 U	11.8 U	0.51 UL	0.51 U	5.43 U	0.549 UL	0.543 U	0.556 U	0.526 U	0.575 U	2.66 U
Acenaphthylene	--	--	0.526 UL	5 U	11.8 U	0.51 UL	0.51 U	5.43 U	0.549 UL	0.543 U	0.556 U	0.526 U	0.575 U	2.66 U
Anthracene	180	Adjusted Tapwater RSL	0.526 UL	5 U	11.8 U	0.51 UL	0.51 U	5.43 U	0.549 UL	0.543 U	0.556 U	0.526 U	0.575 U	2.66 U
Benzyl Butyl Phthalate	16	Adjusted Tapwater RSL	0.526 U	5 U	11.8 U	0.51 U	0.51 U	5.43 U	0.549 U	0.543 U	0.556 U	0.526 U	0.575 U	2.66 U
Bis(2-chloroethyl) Ether	0.014	Adjusted Tapwater RSL	0.526 U	5 U	11.8 U	0.51 U	0.51 U	5.43 U	0.549 U	0.543 U	0.556 U	0.526 U	0.575 U	2.66 U
Bis(2-chloroisopropyl) Ether	71	Adjusted Tapwater RSL	108	139	18.2 J	5.13	0.51 U	5.43 U	0.549 U	0.543 U	0.556 U	18.6	30.4	36.4
Diethyl Phthalate	1500	Adjusted Tapwater RSL	0.526 U	5 U	11.8 U	0.51 U	0.51 U	5.43 U	0.549 U	0.543 U	0.556 U	0.526 U	0.575 U	2.66 U
Fluoranthene	80	Adjusted Tapwater RSL	0.526 U	5 U	11.8 U	0.51 U	0.51 U	5.43 U	0.549 U	0.543 U	0.556 U	0.526 U	0.575 U	2.66 U
Fluorene	29	Adjusted Tapwater RSL	0.526 UL	5 U	11.8 U	0.51 UL	0.51 U	5.43 U	0.549 UL	0.543 U	0.556 U	0.526 U	0.575 U	2.66 U
Naphthalene	0.17	Adjusted Tapwater RSL	0.526 U	5 U	11.8 U	0.51 U	0.51 U	5.43 U	0.549 U	0.543 U	0.556 U	0.526 U	0.575 U	2.66 U
Phenanthrene	--	--	0.526 U	5 U	11.8 U	0.51 U	0.51 U	5.43 U	0.549 U	0.543 U	0.556 U	0.526 U	0.575 U	2.66 U
Phenol	580	Adjusted Tapwater RSL	0.526 U	5 U	11.8 U	1.99	0.51 U	5.43 U	0.549 U	0.543 U	0.556 U	0.526 U	0.575 U	2.66 U
Volatile Organic Compounds (µg/L)														
1,1,2-Trichloroethane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichlorobenzene	600	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	5	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tapwater RSL	165	177 L	190 L	13.1	14	51	1.1 U	0.2 U	0.21 U	151 L	168 L	146 L
Acetone	1400	Adjusted Tapwater RSL	5 UL	13.5	5 U	5 UL	5.16	5 U	5 UL	65.5	25	10.4	11.6	5.45 B
Benzene	5	MCL	1.85	1.77	2.86	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Carbon Disulfide	81	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	100	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	700	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1.06	1 U	1 U	1 U
2-Butanone	560	Adjusted Tapwater RSL	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4-Methyl-2-Pentanone	630	Adjusted Tapwater RSL	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Pyrene	12	Adjusted Tapwater RSL	0.526 U	5 U	11.8 U	0.51 U	0.51 U	5.43 U	0.549 U	0.543 U	0.556 U	0.526 U	0.575 U	2.66 U
Styrene	100	MCL	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	1000	MCL	1 U	1 U	1 U	1 U	1 U	1.17	1 U	1 U	3.64	1 U	1 U	1 U
Xylenes, total	10000	MCL	1 U	1 U	1 U	1 U	1 U	3.35	1 U	1 U	8.12	1 U	1 U	1 U

Notes:

B = The analyte was detected in the associated method and/or calibration blank  
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.  
L = The analyte was positively identified, but the associated numerical value may be biased low.  
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.  
UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.  
UL = The analyte was analyzed for but was not detected. The quantitation limit may be biased low.  
MCL= maximum contaminant level  
RSL= regional screening level  
mg/L = Milligrams per Liter  
µg/L = Micrograms per Liter

Bold indicates the analyte was detected.

Shading indicates the result exceeded screening criteria.

Table 4-1. 2017 Detected Results for Ward Hollow Groundwater  
2017 Groundwater Monitoring Report  
UCC Technology Park, South Charleston, West Virginia

Location	Screening Level	Screening Level Source	MW35				Leachate Collection System		
Sample ID			MW35-GW-022317	MW35-GW-052417	MW35-GW-052417D	MW35-GW-122717	SW01-GW-022217	SW01-GW-060217	SW01-GW-122717
Sample Date			2/23/2017	5/24/2017	5/24/2017	12/27/2017	2/22/2017	6/2/2017	12/27/2017
Analyte									
Metals (mg/L)									
Arsenic	0.01	MCL	0.01 U	0.01 U	0.01 U	0.01 U	0.0219	0.0272	0.0255
Barium	2	MCL	60.7	60.9	60	56.3	3.6	4.54	4.36
Cadmium	0.005	MCL	0.0104	0.0089	0.00851	0.00514	0.00408	0.00319	0.00159
Chromium, total	0.1	MCL	0.00578	0.005 U	0.005 U	0.011	0.005 U	0.005 U	0.005 U
Lead	0.015	MCL	0.0115	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Selenium	0.05	MCL	0.0302	0.00927	0.0096	0.00897	0.0151	0.0104	0.016
Semivolatile Organic Compounds (µg/L)									
2,4-Dimethylphenol	36	Adjusted Tapwater RSL	0.581 U	5.43 U	5.32 U	5.56 U	45.1	15.4	93.3
2-Methylnaphthalene	3.6	Adjusted Tapwater RSL	1.17 L	5.43 U	5.32 U	5.56 U	75.9 L	12.9	78.3
3 & 4 Methylphenol	--	--	0.581 U	5.43 U	5.32 U	5.56 U	181	110	115
Acenaphthene	53	Adjusted Tapwater RSL	0.581 UL	5.43 U	5.32 U	5.56 U	23.3 L	6.93	39.4
Acenaphthylene	--	--	0.581 UL	5.43 U	5.32 U	5.56 U	12.7 L	5.26 U	10.5
Anthracene	180	Adjusted Tapwater RSL	0.581 UL	5.43 U	5.32 U	5.56 U	5.21 UJ	5.26 U	5.88 U
Benzyl Butyl Phthalate	16	Adjusted Tapwater RSL	0.581 U	5.43 U	5.32 U	5.56 U	5.43 U	5.26 U	5.88 U
Bis(2-chloroethyl) Ether	0.014	Adjusted Tapwater RSL	2.13	5.43 U	5.32 U	5.56 U	5.43 U	5.26 U	5.88 U
Bis(2-chloroisopropyl) Ether	71	Adjusted Tapwater RSL	776	664	570	552	879 J	237	1100
Diethyl Phthalate	1500	Adjusted Tapwater RSL	0.581 U	5.43 U	5.32 U	5.56 U	5.21 UJ	5.26 U	5.88 U
Fluoranthene	80	Adjusted Tapwater RSL	0.581 U	5.43 U	5.32 U	5.56 U	5.43 U	5.26 U	5.88 U
Fluorene	29	Adjusted Tapwater RSL	0.581 UL	5.43 U	5.32 U	5.56 U	17.1 L	5.26 U	27.5
Naphthalene	0.17	Adjusted Tapwater RSL	0.581 U	5.43 U	5.32 U	5.56 U	206	562	408
Phenanthrene	--	--	0.581 U	5.43 U	5.32 U	5.56 U	17.6	5.26 U	20.7
Phenol	580	Adjusted Tapwater RSL	0.581 U	5.43 U	5.32 U	5.56 U	225	97.9	599
Volatile Organic Compounds (µg/L)									
1,1,2-Trichloroethane	5	MCL	1 U	1 U	1 U	1 U	1 U	10 U	5 U
1,2-Dichlorobenzene	600	MCL	1 U	1 U	1 U	1 U	1.35	10 U	5 U
1,2-Dichloroethane	5	MCL	1 U	1 U	1 U	1 U	14	13.7	13.6
1,2-Dichloropropane	5	MCL	1 U	1 U	1 U	1 U	75.9	69.4	68.6
1,4-Dioxane (P-dioxane)	0.46	Adjusted Tapwater RSL	156	246 L	221 L	173 L	114	60.3	135
Acetone	1400	Adjusted Tapwater RSL	5.37	5 UL	6.11 L	6.88 B	136 L	324	129 B
Benzene	5	MCL	25.9	25.8	26.3	25.5	35	42.7	40.7
Carbon Disulfide	81	MCL	1 U	1 U	1 U	1 U	1 U	10 U	5 U
Chlorobenzene	100	MCL	1 U	1 U	1 U	1 U	2.59	10 U	5 U
Ethylbenzene	700	MCL	11	9.13	9.3	10	58.1	83.5	75
2-Butanone	560	Adjusted Tapwater RSL	5 U	5 U	5 U	5 U	8.35	50 U	25 U
4-Methyl-2-Pentanone	630	Adjusted Tapwater RSL	5 U	5 UL	5 UL	5 U	18.4	50 U	25 U
Pyrene	12	Adjusted Tapwater RSL	0.581 U	5.43 U	5.32 U	5.56 U	5.43 U	5.26 U	5.88 U
Styrene	100	MCL	1 U	1 U	1 U	1 U	8.65	12.4	11.3
Toluene	1000	MCL	2.36	2.2	2.19	2.23	67.3	85	76.7
Xylenes, total	10000	MCL	4.52	3.63	3.61	4.04	54	72.3	63.4

Notes:

B = The analyte was detected in the associated method and/or calibration blank  
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.  
L = The analyte was positively identified, but the associated numerical value may be biased low.  
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.  
UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.  
UL = The analyte was analyzed for but was not detected. The quantitation limit may be biased low.

MCL= maximum contaminant level

RSL= regional screening level

mg/L = Milligrams per Liter

µg/L = Micrograms per Liter

**Bold indicates the analyte was detected.**

Shading indicates the result exceeded screening criteria.

Table 4-2. 2017 Detected Results for Greenhouse Area Groundwater

2017 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Location	Screening Level	Screening Level Source	MW-104A	WVU-MW04
Sample ID			MW104A-GW-092717	WVUMW04-GW-092717
Sample Date			9/27/2017	9/27/2017
Analyte				
Volatile Organic Compounds (µg/L)				
Chloroform	80	MCL	1 U	1.63 B
cis-1,2-Dichloroethene	70	MCL	1.09	1 U
Tetrachloroethene	5	MCL	1.97	13.2
Trichloroethene	5	MCL	1 U	1.57

**Notes:**

A few analytes had reporting limits higher than screening levels; however, the sampling objectives were still achieved and these instances do not affect our ability to effectively monitor groundwater conditions at the site.

B = The analyte was detected in the associated method and/or calibration blank.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

µg/L = Micrograms per Liter

MCL= maximum contaminant level

**Bold indicates the analyte was detected.**

Shading indicates the result exceeded screening criteria.

Table 4-3. 1,4-Dioxane Results With 8270 SIM and 8270 SIM Isotope Dilution Analytical Methods

2017 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Location	Analytical Method	Screening Level	Screening Level Source	MW-31	MW-32
Sample ID				MW31-GW-121317	MW32-GW-121317
Sample Date				12/13/2017	12/13/2017
Analyte					
Volatile Organic Compounds (µg/L)					
1,4 Dioxane (P-dioxane)	8270 SIM Isotope Dilution	0.46	Adjusted tap water RSL	51	0.21 U
1,4 Dioxane (P-dioxane)	8270 SIM	0.46	Adjusted tap water RSL	23 J	1.1 U

**Notes:**

µg/L = Micrograms per Liter

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

**Bold indicates the analyte was detected.**

Shading indicates the result exceeded screening criteria.

Figures

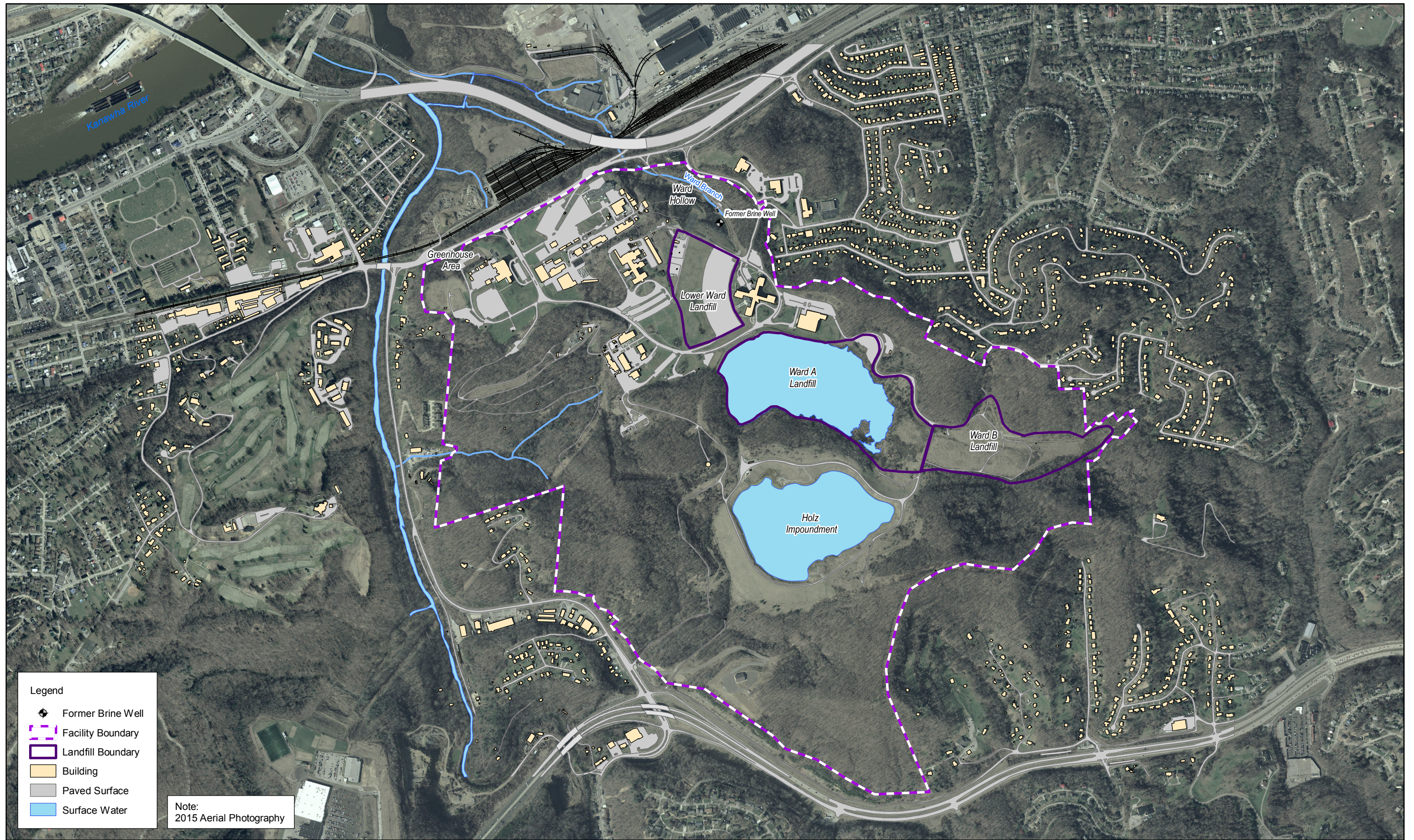
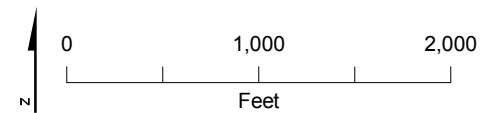


Figure 1-1  
Facility Location Map  
2017 Groundwater Monitoring Report  
UCC Technology Park  
South Charleston, West Virginia



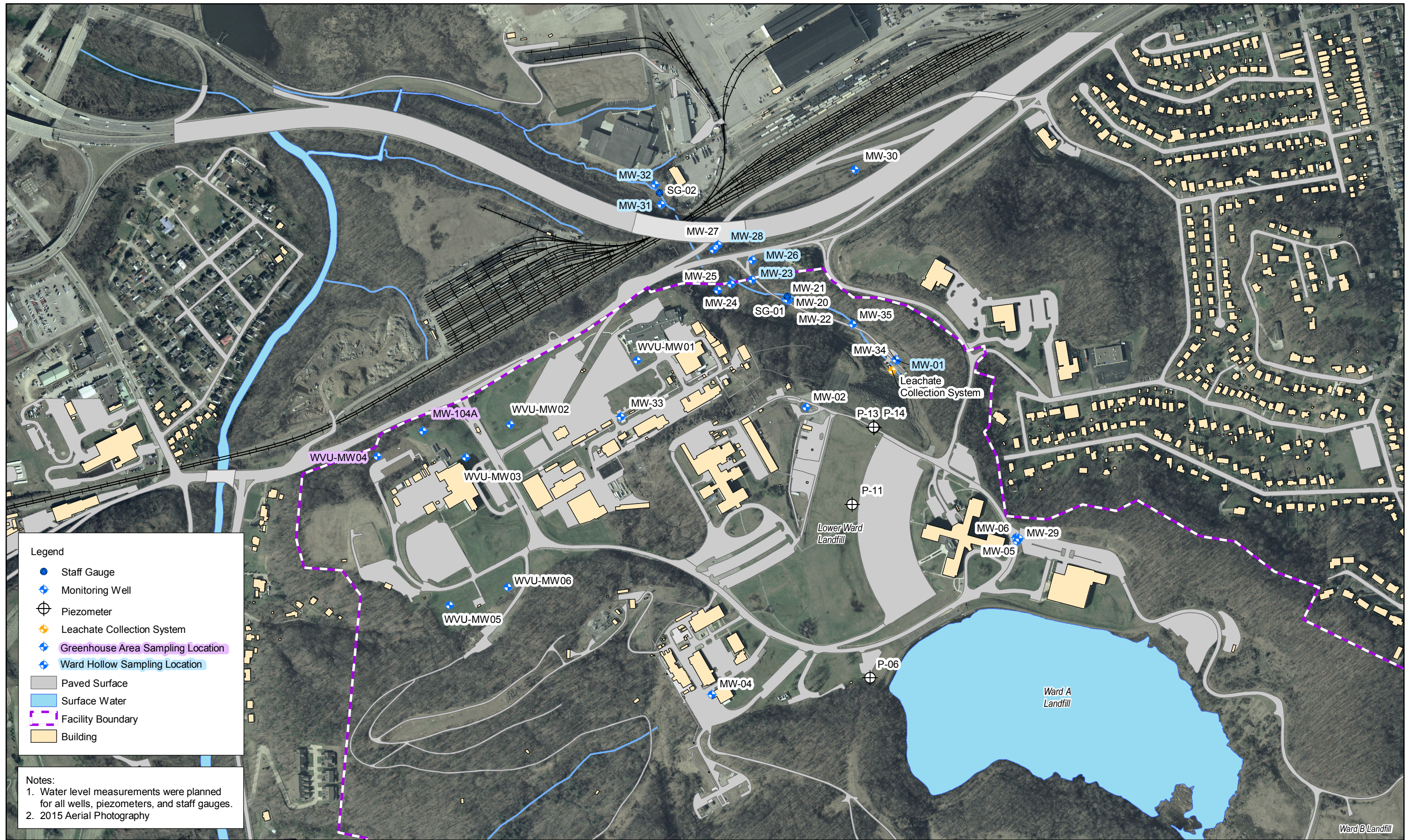
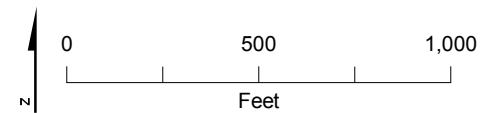
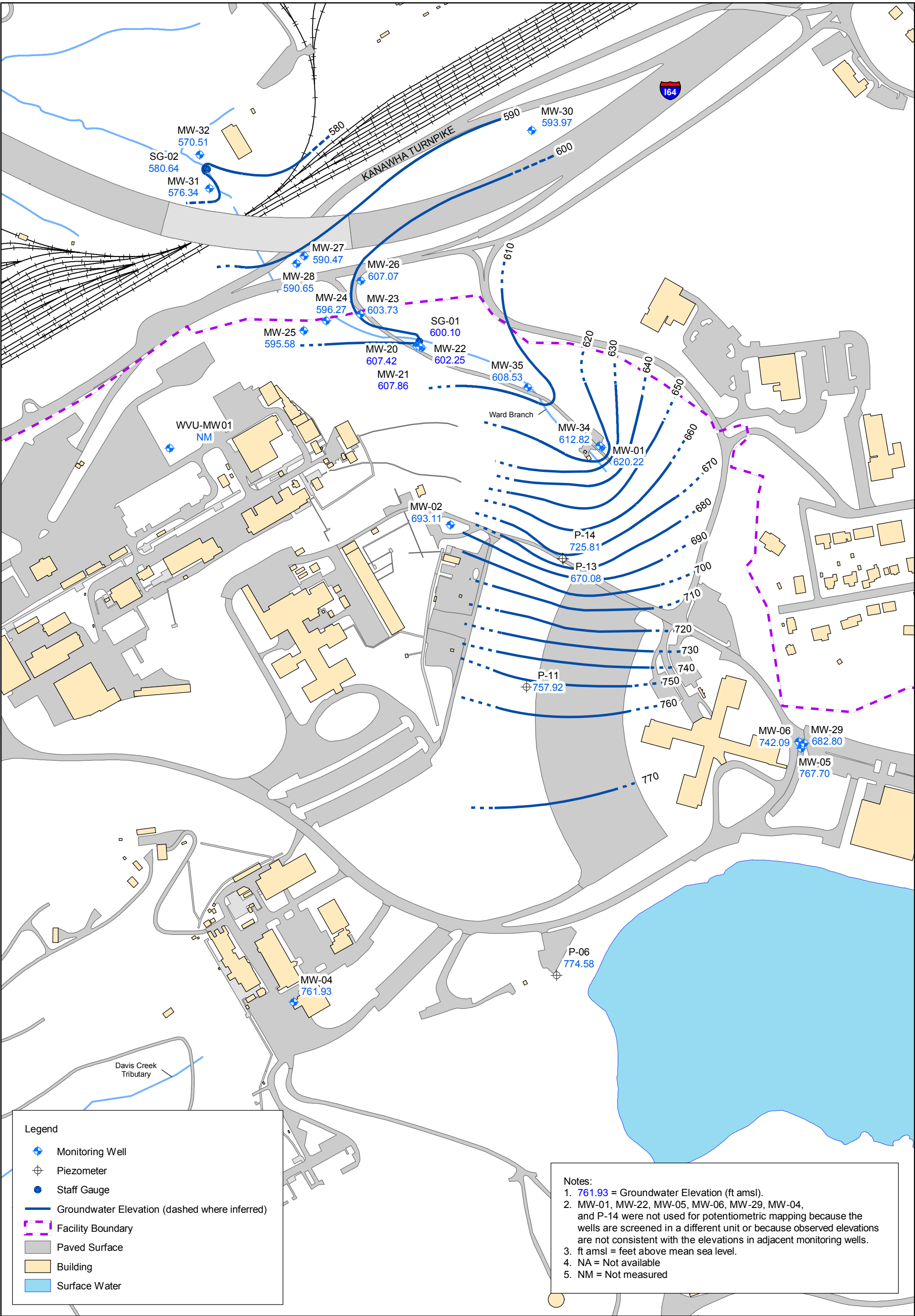
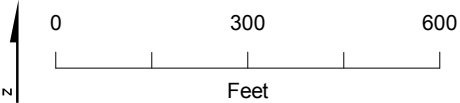


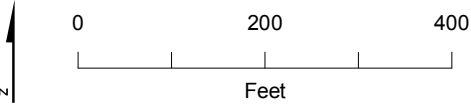
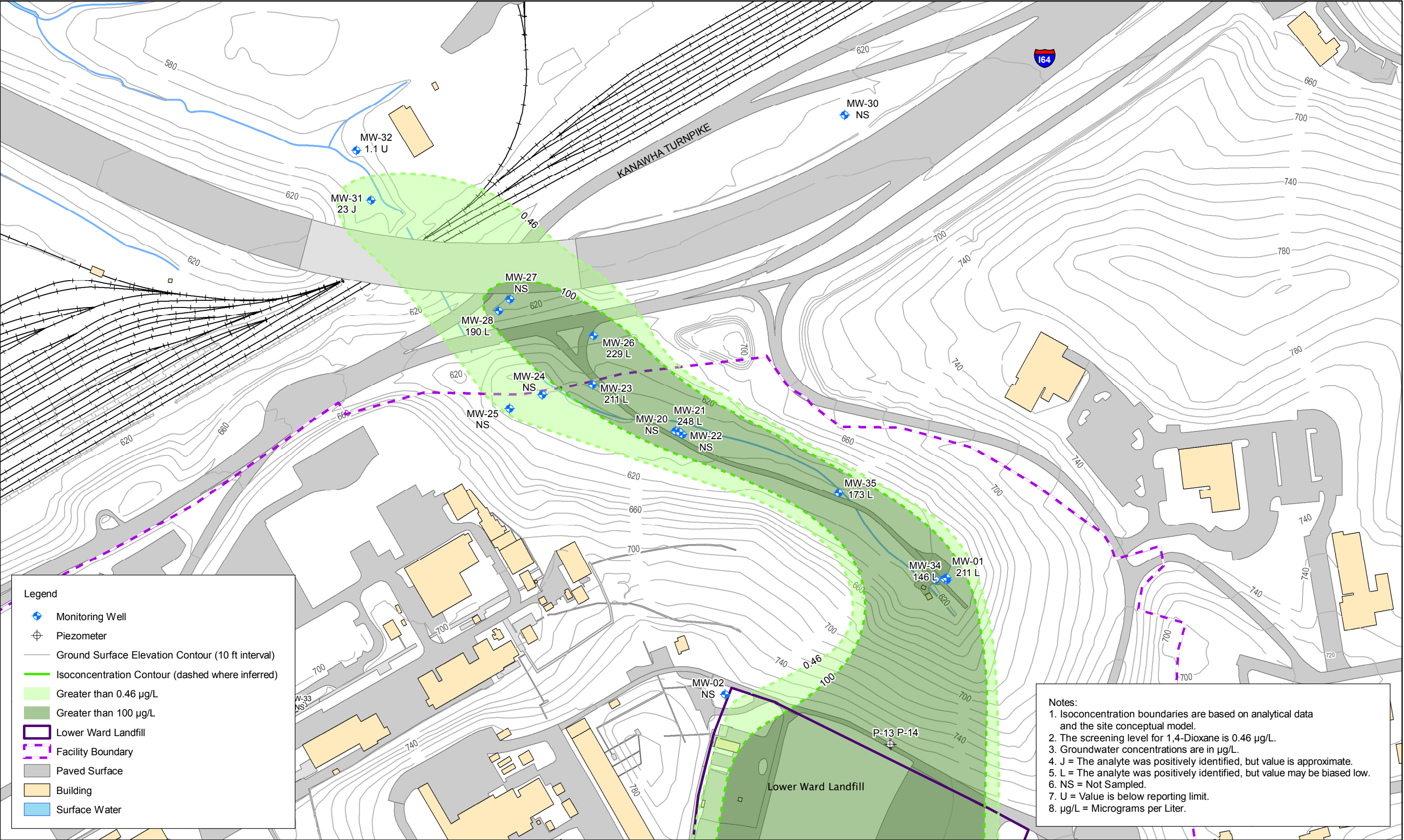
Figure 3-1  
Water Level and Groundwater Sampling Locations  
2017 Groundwater Monitoring Report  
UCC Technology Park  
South Charleston, West Virginia





**Figure 4-1**  
December 2017 Ward Hollow Upper Freeport Potentiometric Surface Map  
2017 Groundwater Monitoring Report  
UCC Technology Park  
South Charleston, West Virginia





**Figure 4-3**  
December 2017 1,4-Dioxane Isoconcentration Map  
2017 Groundwater Monitoring Report  
UCC Technology Park  
South Charleston, West Virginia



**Figure 4.4**  
December 2017 Bis(2-chloroisopropyl)ether Isoconcentration Map  
2017 Groundwater Monitoring Report  
UCC Technology Park  
South Charleston, West Virginia

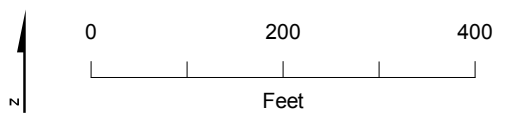
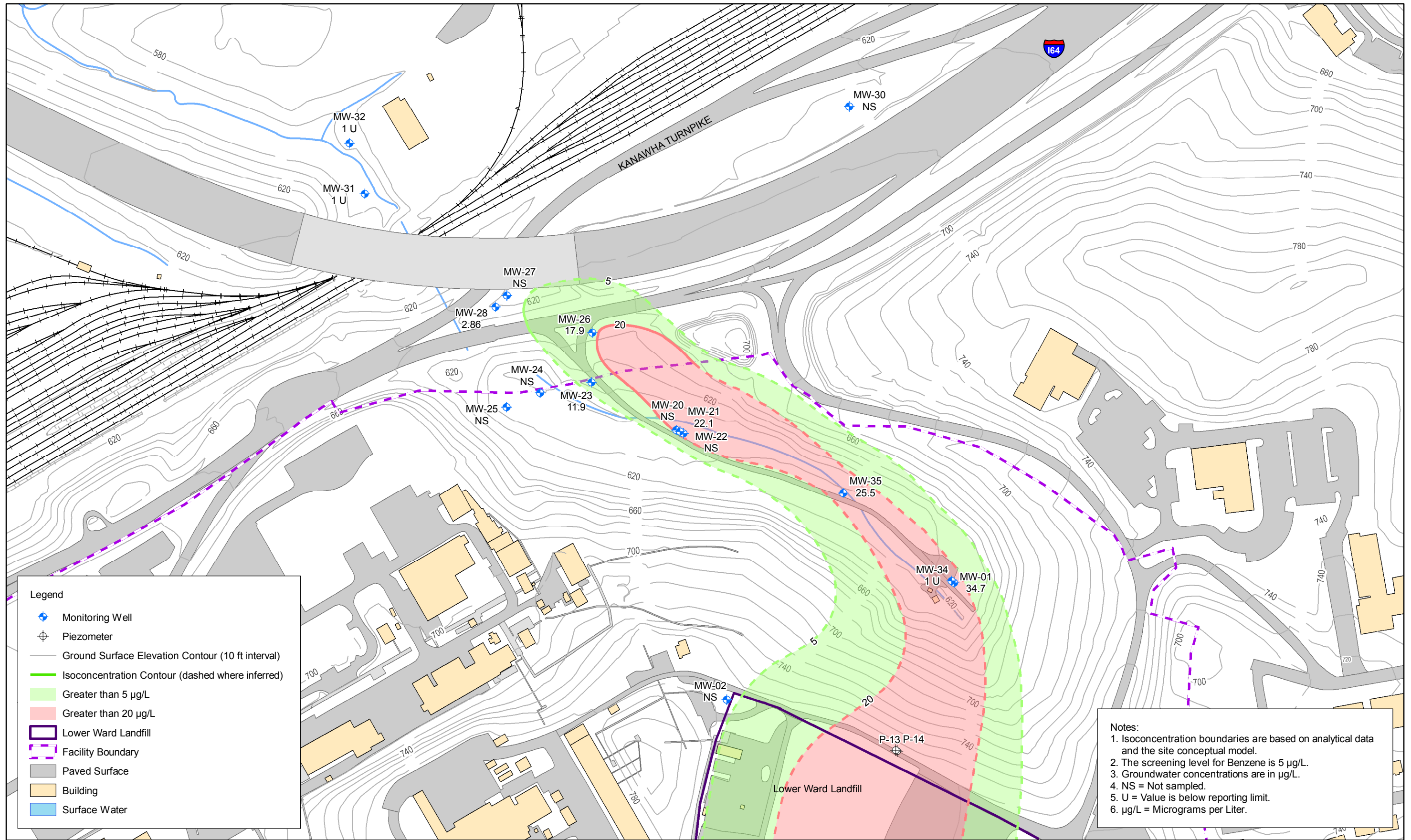
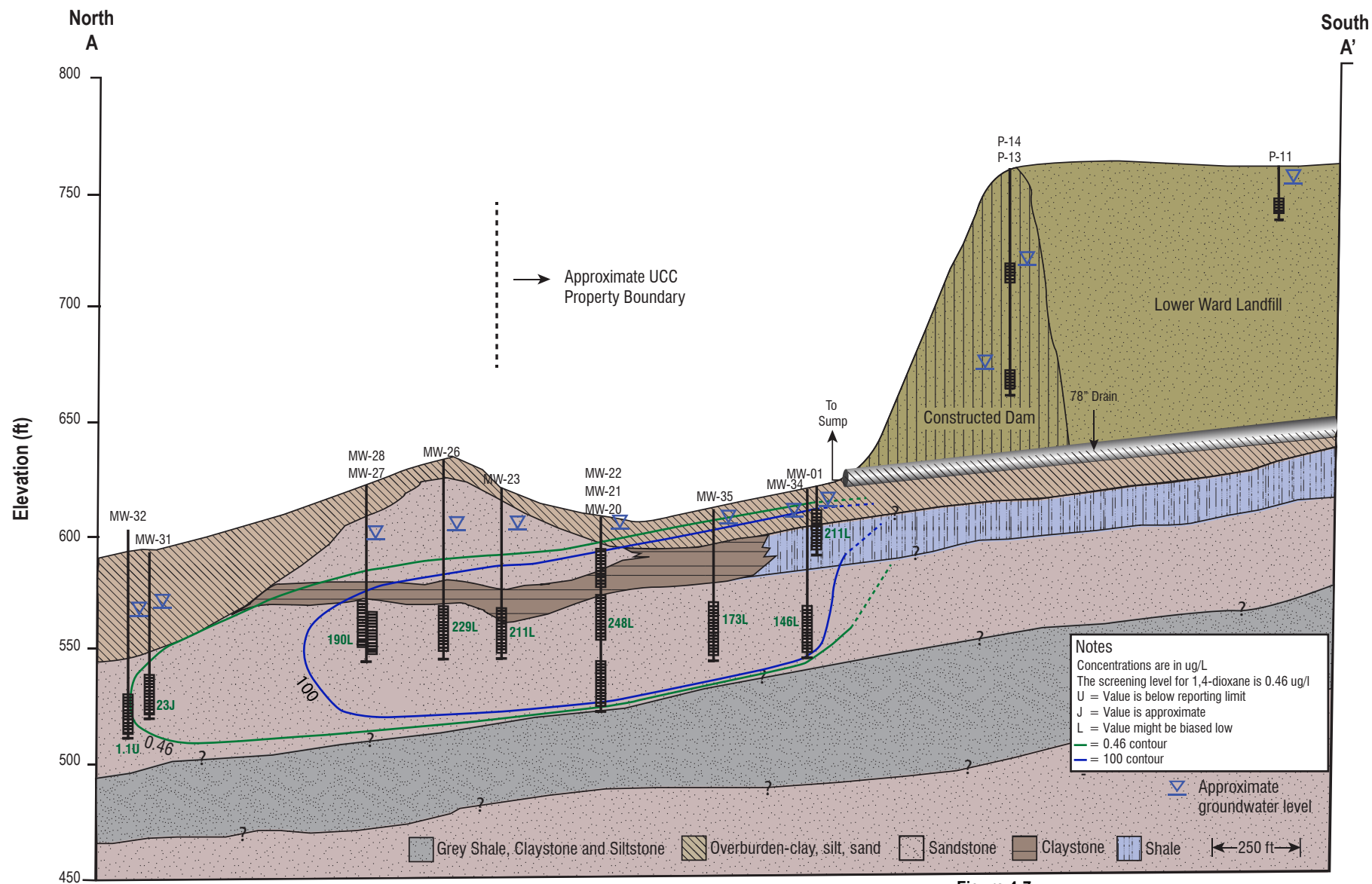


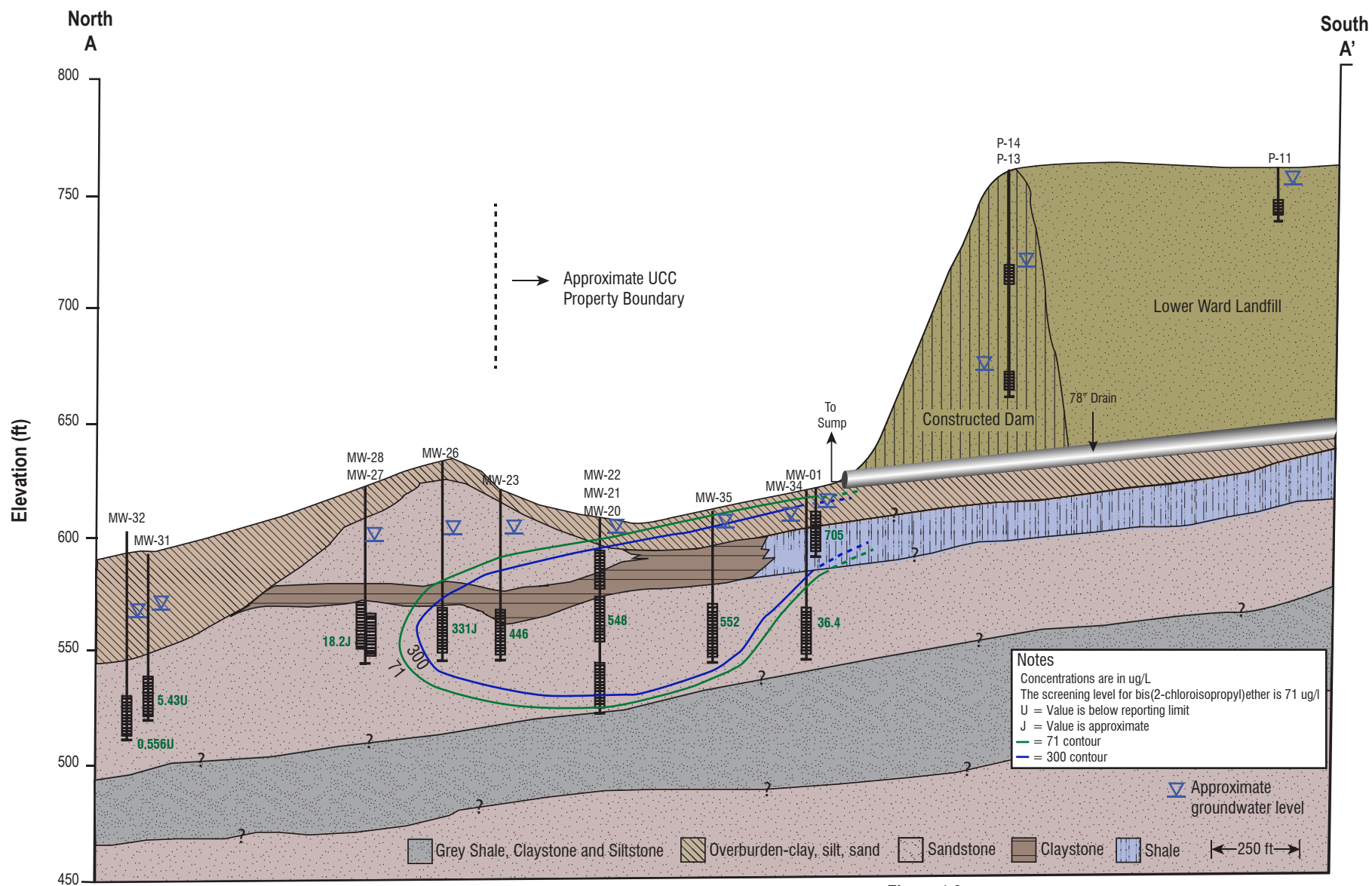
Figure 4-5  
December 2017 Benzene Isoconcentration Map  
2017 Groundwater Monitoring Report  
UCC Technology Park  
South Charleston, West Virginia



**Figure 4-6**  
 December 2017 Dissolved Barium Isoconcentration Map  
 2017 Groundwater Monitoring Report  
 UCC Technology Park  
 South Charleston, West Virginia



**Figure 4-7**  
 December 2017 1,4-Dioxane Vertical Extent Map  
 2017 Groundwater Monitoring Report  
 UCC Technology Park  
 South Charleston, West Virginia



**Figure 4-8**  
 December 2017 Bis(2-chloroisopropyl)ether Vertical Extent Map  
 2017 Groundwater Monitoring Report  
 UCC Technology Park  
 South Charleston, West Virginia

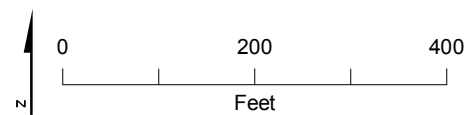
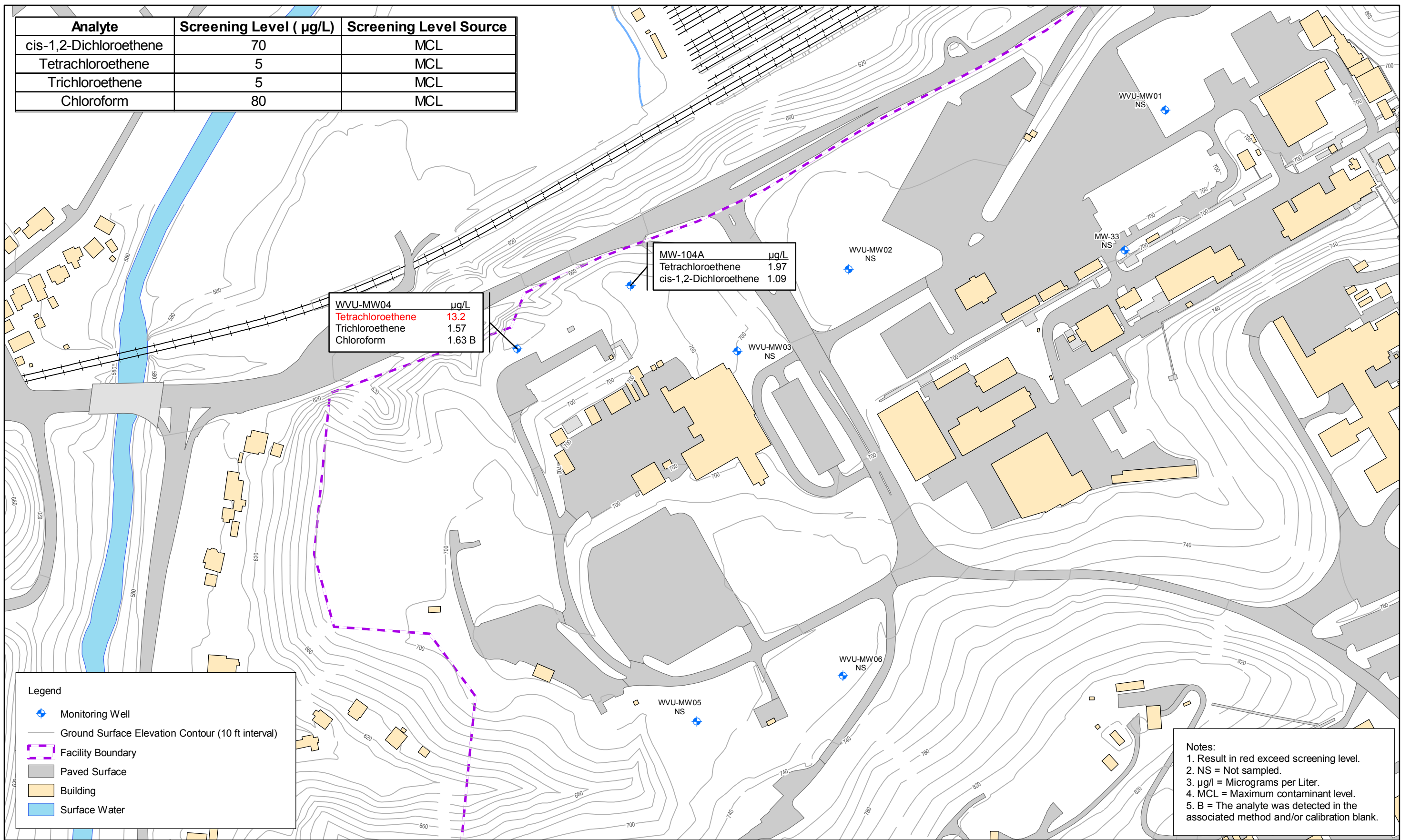
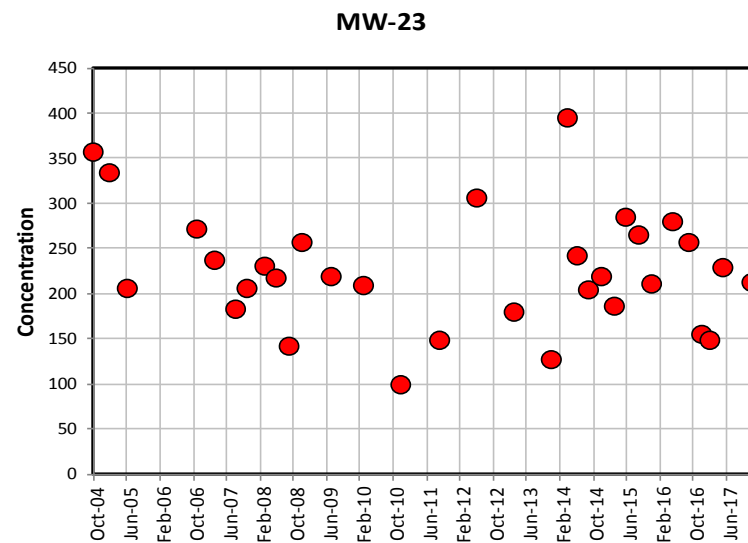
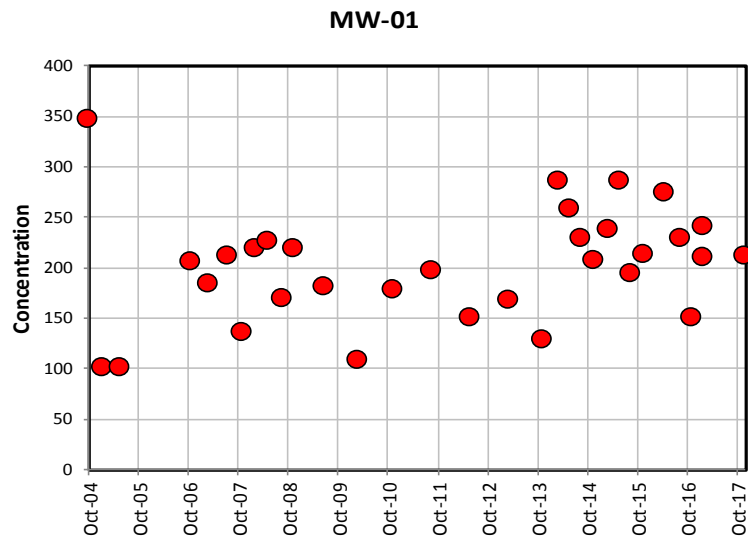


Figure 4-9  
September 2017 Greenhouse Area Groundwater Detections and Exceedances  
2017 Groundwater Monitoring Report  
UCC Technology Park  
South Charleston, West Virginia

Appendix A  
Laboratory Analytical Data Reports  
and Data Quality Evaluation Report  
*(presented on CD)*

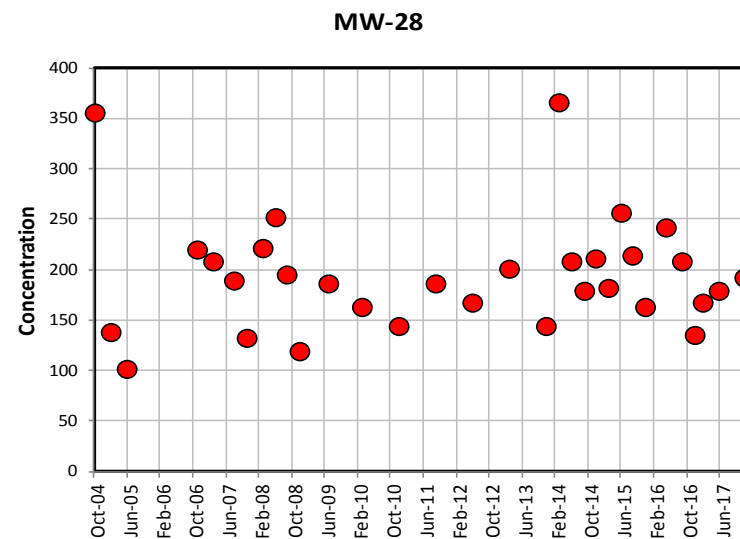
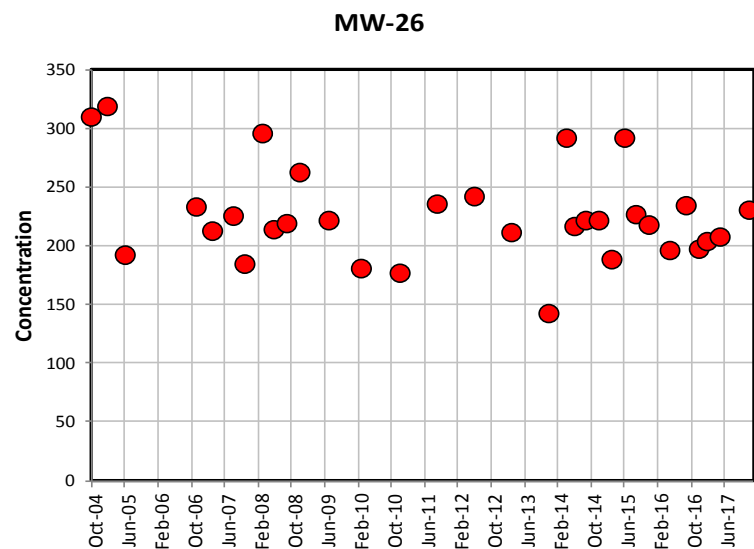
The laboratory analytical data reports and data quality evaluation report are provided on the attached CD-ROM.

Appendix B  
Mann-Kendall Results for  
Plume Stability  
(Summary Tables and Trend Graphs)



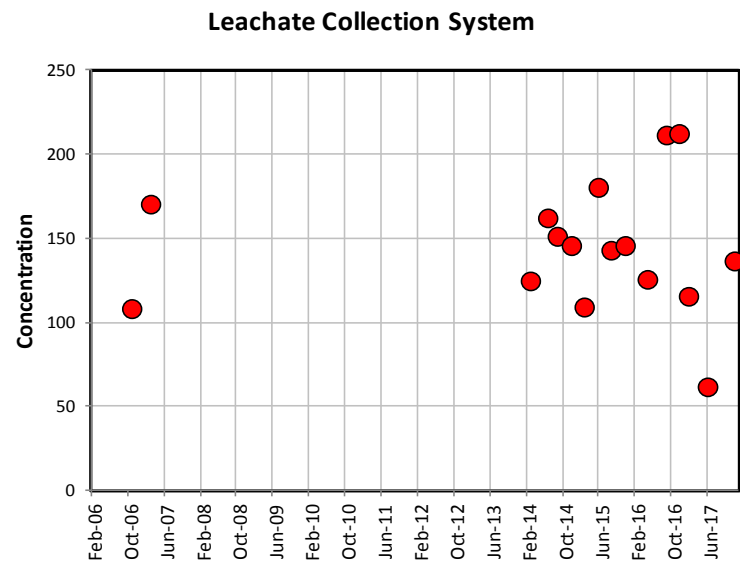
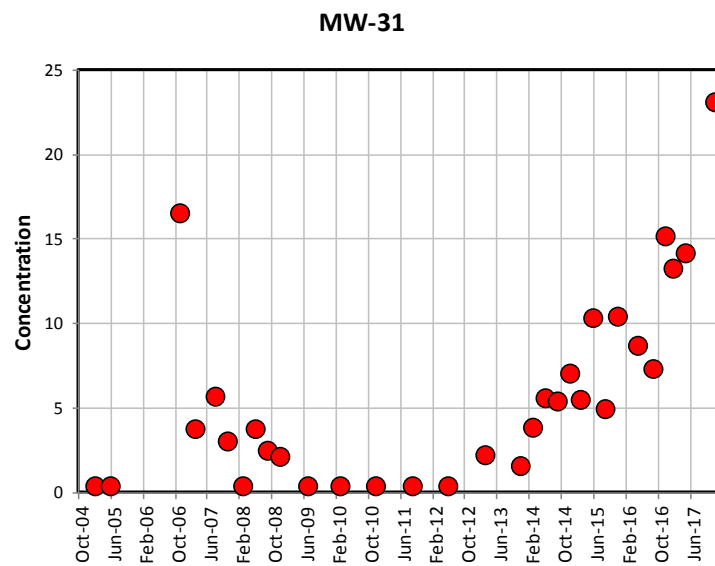
Note:  
 All concentrations in micrograms per liter (µg/L)  
 Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

**Figure B-1. Temporal Concentrations of 1,4-Dioxane in Select Monitoring Wells**  
 2017 Groundwater Monitoring Report  
 UCC Technology Park, South Charleston, West Virginia



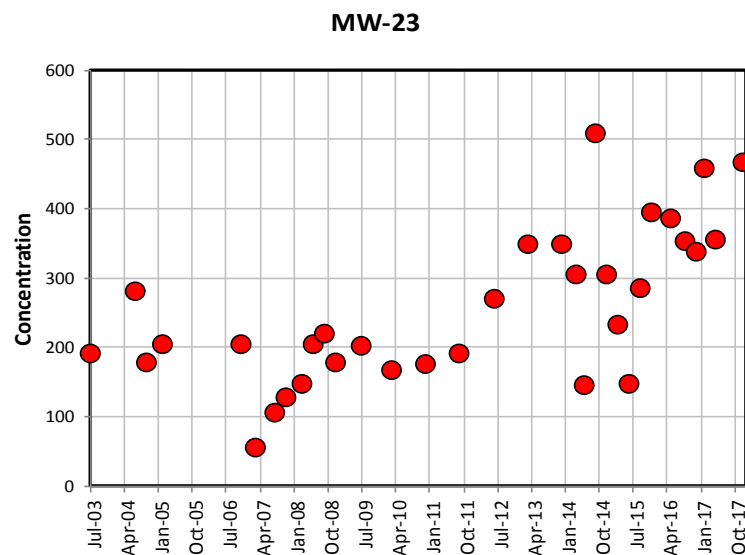
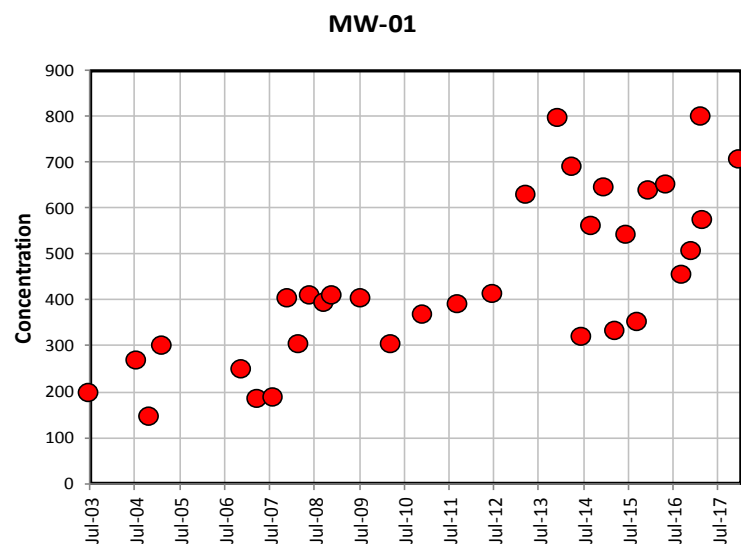
Note:  
 All concentrations in micrograms per liter (µg/L)  
 Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

**Figure B-1. Temporal Concentrations of 1,4-Dioxane in Select Monitoring Wells**  
*2017 Groundwater Monitoring Report*  
*UCC Technology Park, South Charleston, West Virginia*



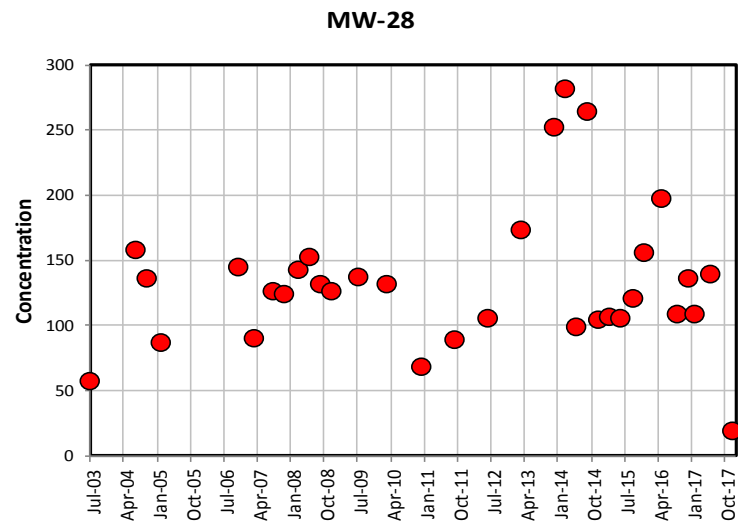
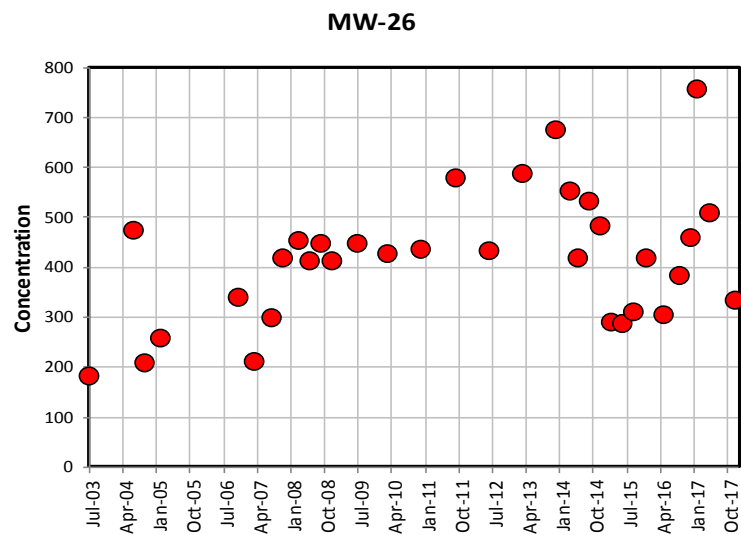
Note:  
 All concentrations in micrograms per liter (µg/L)  
 Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

**Figure B-1. Temporal Concentrations of 1,4-Dioxane in Select Monitoring Wells and Leachate Collection System**  
*2017 Groundwater Monitoring Report*  
*UCC Technology Park, South Charleston, West Virginia*



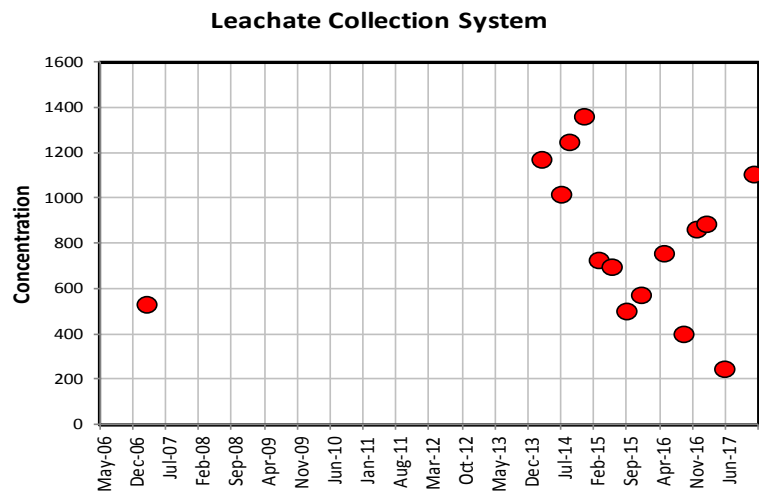
Note:  
 All concentrations in micrograms per liter (µg/L)  
 Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

**Figure B-2. Temporal Concentrations of Bis (2-chloroisopropyl)ether in Select Monitoring Wells**  
 2017 Groundwater Monitoring Report  
 UCC Technology Park, South Charleston, West Virginia



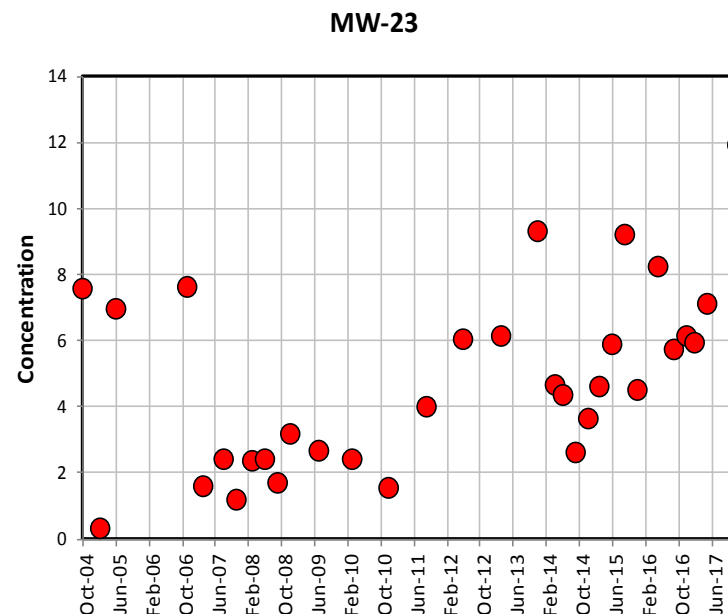
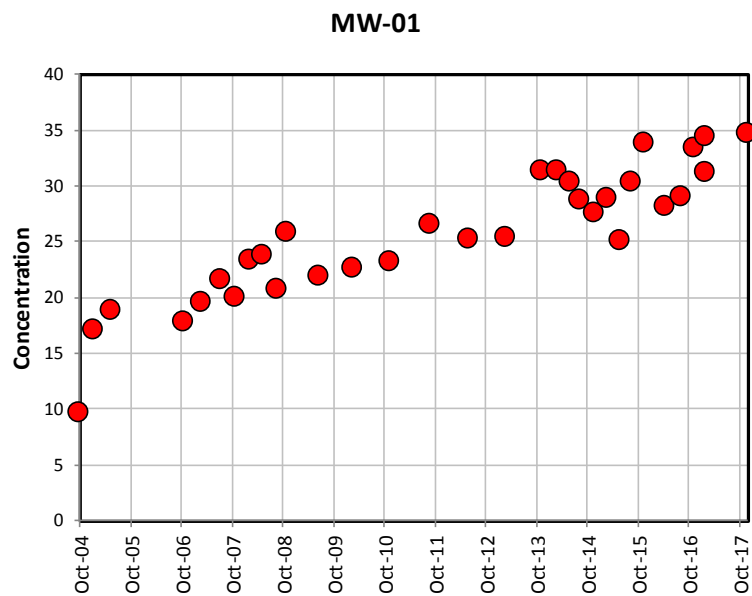
Note:  
 All concentrations in micrograms per liter (µg/L)  
 Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

**Figure B-2. Temporal Concentrations of Bis (2-chloroisopropyl)ether in Select Monitoring Wells**  
 2017 Groundwater Monitoring Report  
 UCC Technology Park, South Charleston, West Virginia



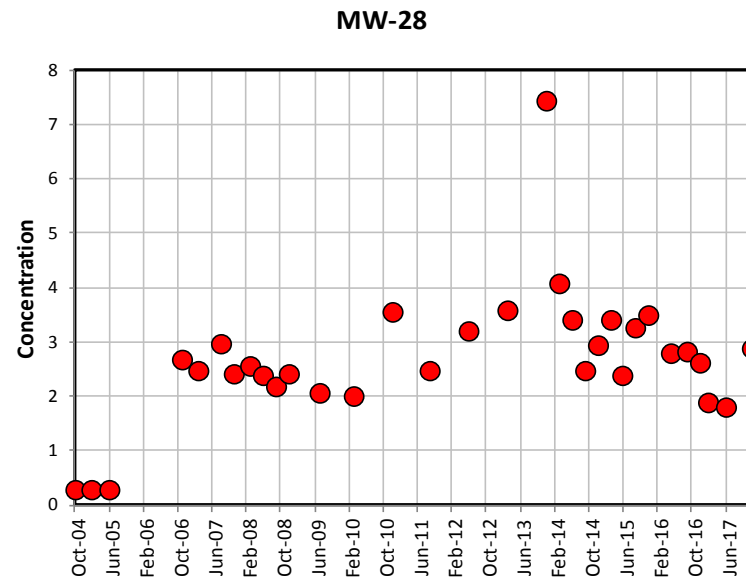
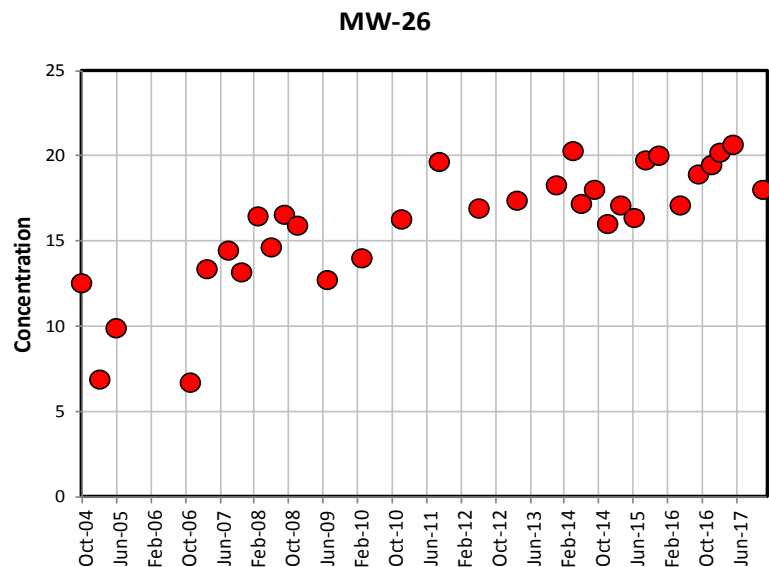
Note:  
 All concentrations in micrograms per liter (µg/L)  
 Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

**Figure B-2. Temporal Concentrations of Bis (2-chloroisopropyl)ether in Leachate Collection System**  
 2017 Groundwater Monitoring Report  
 UCC Technology Park, South Charleston, West Virginia



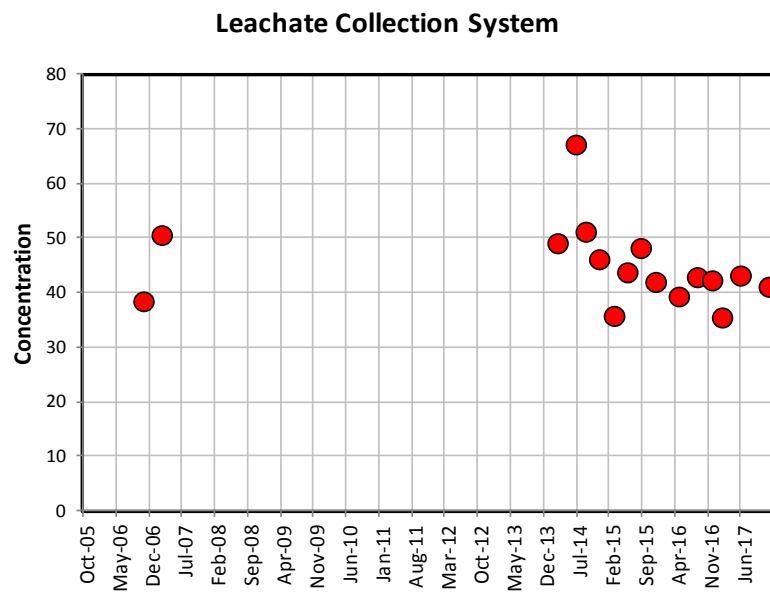
Note:  
 All concentrations in micrograms per liter (µg/L)  
 Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

**Figure B-3. Temporal Concentrations of Benzene in Select Monitoring Wells**  
*2017 Groundwater Monitoring Report*  
*UCC Technology Park, South Charleston, West Virginia*



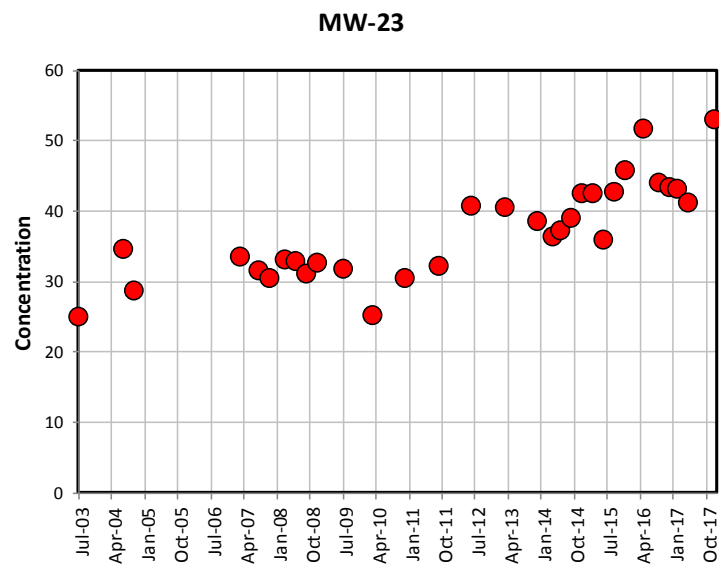
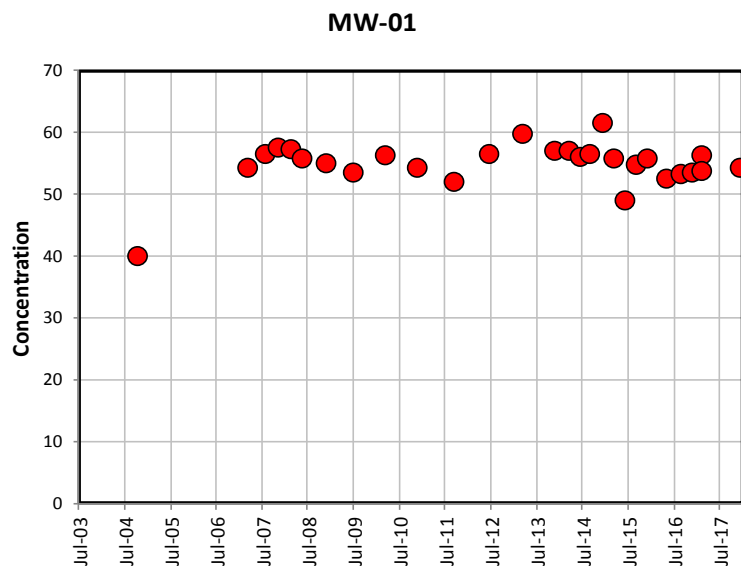
Note:  
 All concentrations in micrograms per liter (µg/L)  
 Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

**Figure B-3. Temporal Concentrations of Benzene in Select Monitoring Wells**  
*2017 Groundwater Monitoring Report*  
*UCC Technology Park, South Charleston, West Virginia*



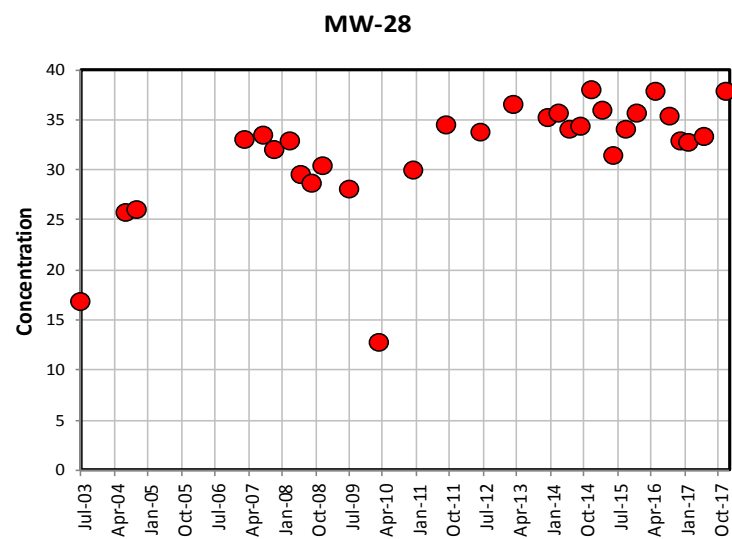
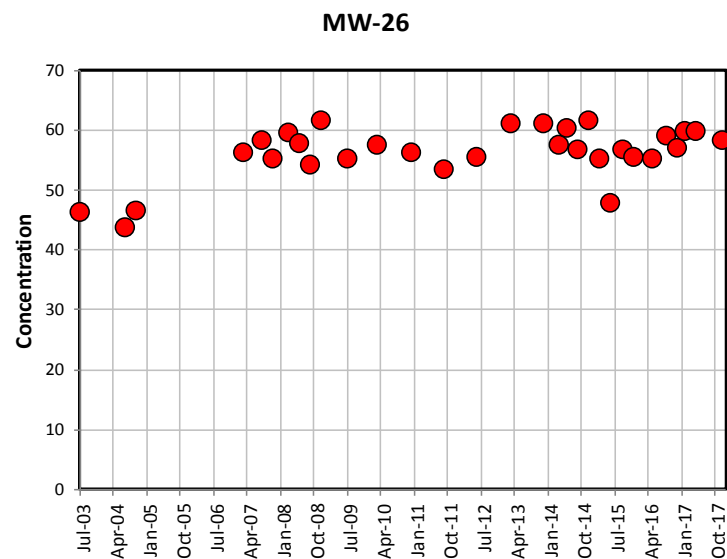
Note:  
 All concentrations in micrograms per liter (µg/L)  
 Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

**Figure B-3. Temporal Concentrations of Benzene in Leachate Collection System**  
*2017 Groundwater Monitoring Report*  
*UCC Technology Park, South Charleston, West Virginia*



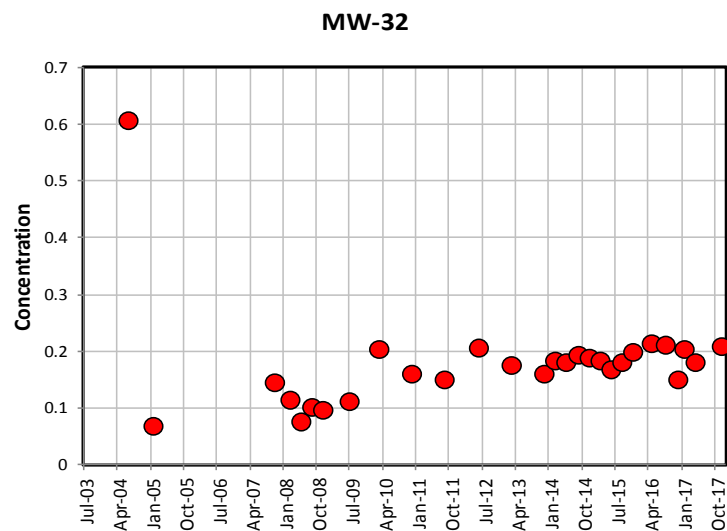
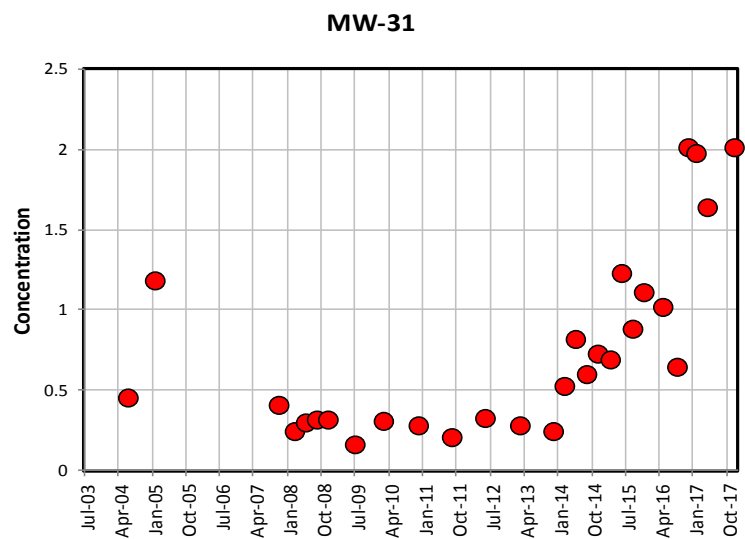
Note:  
 All concentrations in milligrams per liter (mg/L)  
 Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

**Figure B-4. Temporal Concentrations of Barium in Select Monitoring Wells**  
 2017 Groundwater Monitoring Report  
 UCC Technology Park, South Charleston, West Virginia



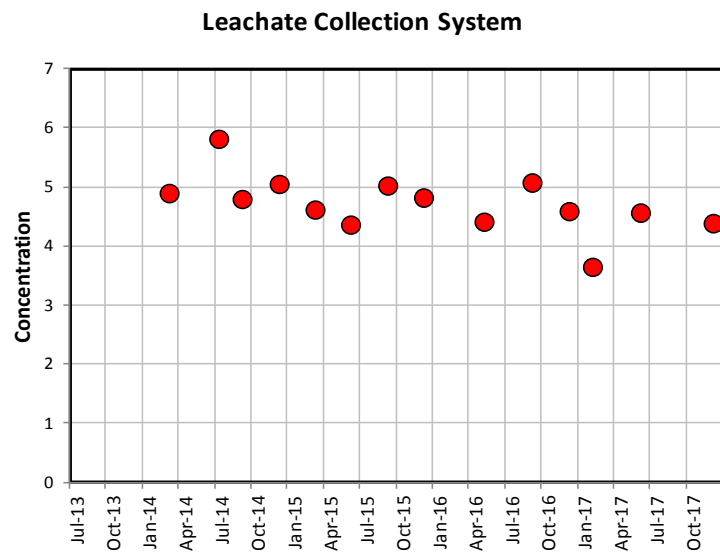
Note:  
 All concentrations in milligrams per liter (mg/L)  
 Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

**Figure B-4. Temporal Concentrations of Barium in Select Monitoring Wells**  
*2017 Groundwater Monitoring Report*  
*UCC Technology Park, South Charleston, West Virginia*



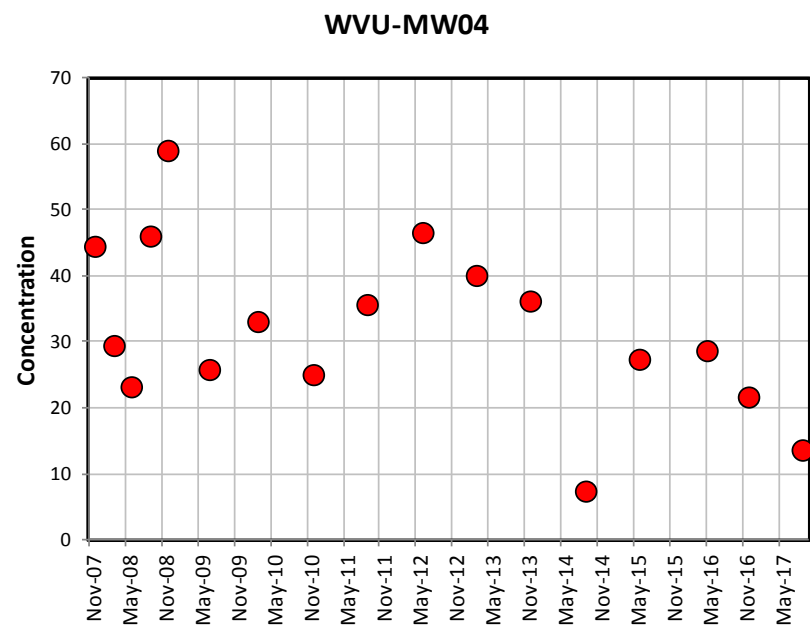
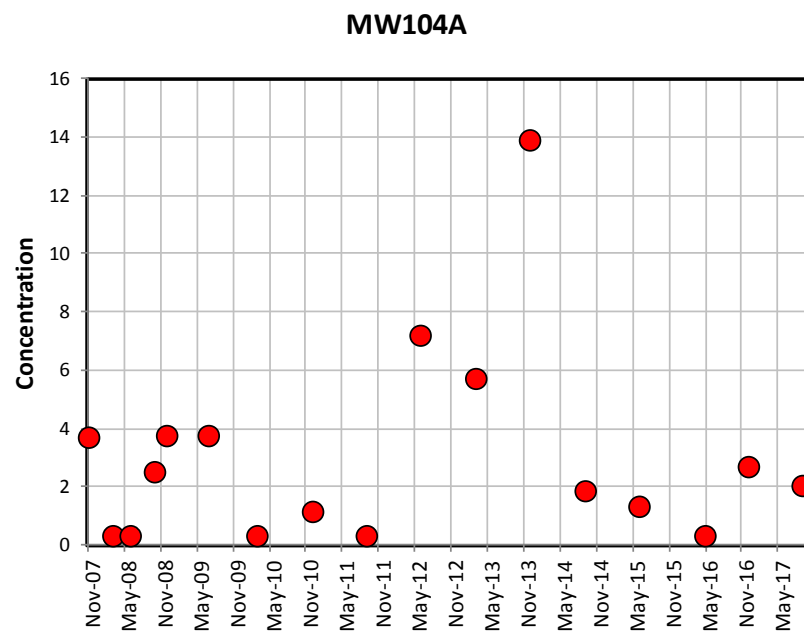
Note:  
 All concentrations in milligrams per liter (mg/L)  
 Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

**Figure B-4. Temporal Concentrations of Barium in Select Monitoring Wells**  
 2017 Groundwater Monitoring Report  
 UCC Technology Park, South Charleston, West Virginia



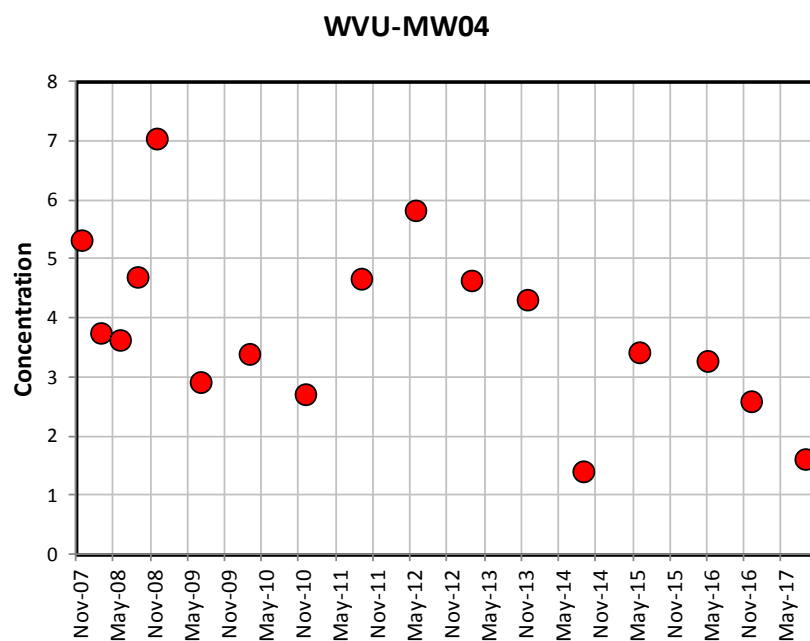
Note:  
 All concentrations in milligrams per liter (mg/L)  
 Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

**Figure B-4. Temporal Concentrations of Barium in Leachate Collection System**  
*2017 Groundwater Monitoring Report*  
*UCC Technology Park, South Charleston, West Virginia*



Note:  
 All concentrations in micrograms per liter (µg/L)  
 Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

**Figure B-5. Temporal Concentrations of Tetrachloroethene in Select Monitoring Wells**  
 2017 Groundwater Monitoring Report  
 UCC Technology Park, South Charleston, West Virginia



Note:  
All concentrations in micrograms per liter (µg/L)  
Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

**Figure B-6. Temporal Concentrations of Trichloroethene in Select Monitoring Well**  
*2017 Groundwater Monitoring Report*  
*UCC Technology Park, South Charleston, West Virginia*

**Table B-1. Nonparametric (Mann-Kendall) Trend Analysis for 1,4-Dioxane, Individual Monitoring Wells and Leachate Collection System**

2017 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (µg/L)	Maximum (µg/L)	Mean (µg/L)	Median (µg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
MW-01	32	0	32	100	100	347	201	209	96.3% (sig +)	Increasing Trend	NA
MW-23	32	0	32	100	98.4	393	224	217	77.2% (-)	No Trend	Stable
MW-26	32	0	32	100	141	318	225	219	83.5% (-)	No Trend	Stable
MW-28	32	0	32	100	100	364	193	186	58.3% (+)	No Trend	Stable
MW-31	23	8	31	74	0.257	23.0	5.64	3.77	100.0% (sig +)	Increasing Trend	NA
MW-32	0	32	32	0	0.257	0.257	0.257	0.257	NA	>50% ND	NA
Leachate Collection System	16	0	16	100	60.3	211	143	143	57.1% (-)	No Trend	Stable

Notes:

µg/L = micrograms per liter.

NA = not applicable.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

>50% ND = greater than 50 percent nondetects.

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

(-) = negative trend

(+) = positive trend

**Table B-2. Nonparametric (Mann-Kendall) Trend Analysis for Bis (2-chloroisopropyl)ether, Individual Monitoring Wells and Leachate Collection System**

2017 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (µg/L)	Maximum (µg/L)	Mean (µg/L)	Median (µg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
MW-01	33	0	33	100	143	799	438	403	100.0% (sig +)	Increasing Trend	NA
MW-23	33	0	33	100	54.3	508	256	218	100.0% (sig +)	Increasing Trend	NA
MW-26	33	0	33	100	181	756	415	418	96.4% (sig +)	Increasing Trend	NA
MW-28	33	0	33	100	18.2	281	132	126	63.9% (+)	No Trend	Stable
MW-31	3	27	30	10	0.257	5.13	0.472	0.257	NA	>50% ND	NA
MW-32	4	26	30	13	0.257	1.55	0.365	0.257	NA	>50% ND	NA
Leachate Collection System	15	0	15	100	237	1,350	797	746	78.2% (-)	No Trend	Stable

Notes:

µg/L = micrograms per liter.

NA = not applicable.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

>50% ND = greater than 50 percent nondetects.

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level.

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

(+) = positive trend

(-) = negative trend

**Table B-3. Nonparametric (Mann-Kendall) Trend Analysis for Benzene, Individual Monitoring Wells and Leachate Collection System**

2017 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (µg/L)	Maximum (µg/L)	Mean (µg/L)	Median (µg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
MW-01	32	0	32	100	9.66	34.7	25.6	25.5	100.0% (sig +)	Increasing Trend	NA
MW-23	31	1	32	97	0.257	11.90	4.78	4.52	99.9% (sig +)	Increasing Trend	NA
MW-26	32	0	32	100	6.60	20.6	16.0	16.7	100.0% (sig +)	Increasing Trend	NA
MW-28	29	3	32	91	0.257	7.41	2.64	2.55	94.9% (+)	No Trend	Stable
MW-31	6	26	32	19	0.257	4.46	0.730	0.257	NA	>50% ND	NA
MW-32	4	28	32	13	0.257	14.4	0.876	0.257	NA	>50% ND	NA
Leachate Collection System	16	0	16	100	35.0	66.7	44.4	42.6	97.4% (sig -)	Decreasing Trend	NA

Notes:

(µg/L) = micrograms per liter.

NA = not applicable.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

>50% ND = greater than 50 percent nondetects.

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

(+) = positive trend

(-) = negative trend

**Table B-4. Nonparametric (Mann-Kendall) Trend Analysis for Barium, Individual Monitoring Wells and Leachate Collection System**

2017 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
MW-01	28	0	28	100	39.8	61.3	54.6	55.5	82.3% (-)	No Trend	Stable
MW-23	31	0	31	100	25.0	52.9	37.1	36.3	100.0% (sig +)	Increasing Trend	NA
MW-26	31	0	31	100	43.7	61.5	56.0	56.7	96.7% (sig +)	Increasing Trend	NA
MW-28	31	0	31	100	12.7	37.9	31.8	33.2	100.0% (sig +)	Increasing Trend	NA
MW-31	28	0	28	100	0.146	2.00	0.733	0.553	100.0% (sig +)	Increasing Trend	NA
MW-32	28	0	28	100	0.065	0.603	0.175	0.177	99.9% (sig +)	Increasing Trend	NA
Leachate Collection System	14	0	14	100	3.60	5.78	4.68	4.66	98.2% (sig -)	Decreasing Trend	NA

Notes:

mg/L = milligrams per liter.

NA = not applicable.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set.

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

(-) = negative trend

(+) = positive trend

**Table B-5. Post-2011 Nonparametric (Mann-Kendall) Trend Analysis for 1,4-Dioxane, Individual Monitoring Wells and Leachate Collection System**

2017 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (µg/L)	Maximum (µg/L)	Mean (µg/L)	Median (µg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
MW-01	18	0	18	100	128	285	215	212	74.0% (+)	No Trend	Stable
MW-23	18	0	18	100	126	393	224	215	51.5% (-)	No Trend	Stable
MW-26	18	0	18	100	141	291	220	219	71.5% (-)	No Trend	Stable
MW-28	18	0	18	100	134	364	198	187	59.0% (-)	No Trend	Stable
MW-31	16	2	18	89	0.257	23.0	7.60	6.16	100.0% (sig +)	Increasing Trend	NA
MW-32	0	18	18	0	0.257	0.257	0.257	0.257	NA	>50% ND	NA
Leachate Collection System	14	0	14	100	60	211	143	143	68.6% (-)	No Trend	Stable

Notes:

µg/L = micrograms per liter.

NA = not applicable.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set.

>50% ND = greater than 50 percent nondetects.

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level.

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

(-) = negative trend

(+) = positive trend

**Table B-6. Post-2011 Nonparametric (Mann-Kendall) Trend Analysis for Bis (2-chloroisopropyl)ether, Individual Monitoring Wells and Leachate Collection System**  
 2017 Groundwater Monitoring Report  
 UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (µg/L)	Maximum (µg/L)	Mean (µg/L)	Median (µg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
MW-01	18	0	18	100	319	799	554	567	87.2% (+)	No Trend	Stable
MW-23	18	0	18	100	144	508	323	343	98.1% (sig +)	Increasing Trend	NA
MW-26	18	0	18	100	286	756	460	445	90.8% (-)	No Trend	Stable
MW-28	18	0	18	100	18.2	281	142	114	53.0% (+)	No Trend	Stable
MW-31	3	15	18	17	0.257	5.13	0.615	0.257	NA	>50% ND	NA
MW-32	4	14	18	22	0.257	1.55	0.438	0.257	NA	>50% ND	NA
Leachate Collection System	15	0	15	100	237	1,350	797	746	78.2% (-)	No Trend	Stable

Notes:

µg/L = micrograms per liter.

NA = not applicable.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set.

>50% ND = greater than 50 percent nondetects.

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level.

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one.

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent.
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one.

(+) = positive trend

(-) = negative trend

**Table B-7. Post-2011 Nonparametric (Mann-Kendall) Trend Analysis for Benzene, Individual Monitoring Wells and Leachate Collection System**

*2017 Groundwater Monitoring Report*

*UCC Technology Park, South Charleston, West Virginia*

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (µg/L)	Maximum (µg/L)	Mean (µg/L)	Median (µg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
MW-01	18	0	18	100	25.1	34.7	29.7	29.6	99.4% (sig +)	<b>Increasing Trend</b>	NA
MW-23	18	0	18	100	2.56	11.9	6.08	5.88	95.2% (sig +)	<b>Increasing Trend</b>	NA
MW-26	18	0	18	100	15.9	20.6	18.3	18.1	88.7% (+)	<b>No Trend</b>	<b>Stable</b>
MW-28	18	0	18	100	1.77	7.41	3.13	2.89	98.0% (sig -)	<b>Decreasing Trend</b>	NA
MW-31	2	16	18	11	0.257	4.46	0.554	0.257	NA	>50% ND	NA
MW-32	3	15	18	17	0.257	14.4	1.31	0.257	NA	>50% ND	NA
Leachate Collection System	14	0	14	100	35.0	66.7	44.4	42.6	99.3% (sig -)	<b>Decreasing Trend</b>	NA

Notes:

µg/L = micrograms per liter.

NA = not applicable.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set.

>50% ND = greater than 50 percent nondetects.

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level.

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one.

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent.
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one.

(+) = positive trend

(-) = negative trend

**Table B-8. Post-2011 Nonparametric (Mann-Kendall) Trend Analysis for Barium, Individual Monitoring Wells and Leachate Collection System for Data**

2017 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Median (mg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
MW-01	18	0	18	100	48.8	61.3	55.1	55.5	95.6% (sig -)	Decreasing Trend	NA
MW-23	18	0	18	100	32.2	52.9	41.6	41.7	99.8% (sig +)	Increasing Trend	NA
MW-26	18	0	18	100	47.6	61.5	57.2	57.3	60.5% (+)	No Trend	Stable
MW-28	18	0	18	100	31.4	37.9	34.9	34.8	66.2% (-)	No Trend	Stable
MW-31	18	0	18	100	0.193	2.00	0.927	0.759	100.0% (sig +)	Increasing Trend	NA
MW-32	18	0	18	100	0.145	0.211	0.181	0.179	94.0% (+)	No Trend	Stable
Leachate Collection System	14	0	14	100	3.60	5.78	4.68	4.66	98.2% (sig -)	Decreasing Trend	NA

Notes:

mg/L = milligrams per liter.

NA = not applicable.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

(-) = negative trend

(+) = positive trend

**Table B-9. Nonparametric (Mann-Kendall) Trend Analysis for Tetrachloroethene, Individual Monitoring Wells**

2017 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (µg/L)	Maximum (µg/L)	Mean (µg/L)	Median (µg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
MW104A	12	5	17	71	0.257	13.8	2.94	1.97	68.9% (+)	No Trend	Not Stable
WVU-MW04	17	0	17	100	7.12	58.7	31.6	29.1	94.6% (-)	No Trend	Stable

Notes:

µg/L = micrograms per liter.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level.

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one

(-) = negative trend

(+) = positive trend

**Table B-10. Nonparametric (Mann-Kendall) Trend Analysis for Trichloroethene, Individual Monitoring Wells**

2017 Groundwater Monitoring Report

UCC Technology Park, South Charleston, West Virginia

Monitoring Well	No. of Detected Samples	No. of Nondetected Samples	Total Samples	Detection Frequency (%)	Minimum (µg/L)	Maximum (µg/L)	Mean (µg/L)	Median (µg/L)	Mann-Kendall Result (% Confidence)	Trend	Stability
MW104A	0	17	17	0	0.257	0.257	0.257	0.257	NA	>50% ND	NA
WVU-MW04	17	0	17	100	1.36	7.01	3.80	3.59	99.1% (sig -)	Decreasing Trend	NA

Notes:

µg/L = micrograms per liter.

Nondetects were assigned a common value that is smaller than the smallest measured value in the data set.

>50% ND = greater than 50 percent nondetects.

Trend analysis performed using Mann Kendall single-tailed test at 0.05 significance level.

For monitoring points exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one.

- A weak trend (either increasing or decreasing) will be indicated by a confidence level less than 95 percent but greater than or equal to 90 percent.
- For a constituent exhibiting no trend at the 95% confidence level, concentrations are deemed stable if the coefficient of variation (COV) is equal to or less than one.

(-) = negative trend